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Japan Report

(FOUO 28/81)

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JAPAN REPORT

(FOUO 28/81)

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POLITICAL AND SOCIOLOGICAL

POLITICAL IMPACT OF U.S.-JAPAN AUTO ISSUE ANALYZED

Tokyo NIHON KEIZAI SHIMBUN in Japanese 28 Mar 81 p 3

[Text] The Japan-U.S. discussions on the automobile problem will begin in earnest next month. As the content of the American Government's demands to Japan becomes clear, it is gradually becoming obvious that this is a political problem. The scenario seems to be for "Japan, as an ally of the United States, to show a cooperative attitude in helping to build a strong America by voluntary cutbacks on automobile exports for a while." The upshot is that auto export cutbacks will be traded for defense assistance, Japan's biggest concern.

According to the estimate of the Industrial Bank of Japan, if automobile exports are held to 1979 levels, our total industrial production will fall by 650 billion yen and employment will drop by 45,000. Is this political price paid by Japan as an American ally high or low?

Many people point to Japan's defense problem as the greatest political issue between Japan and the United States. However, the United States has focused on cars. Foreign Minister Ito's first statement on returning from the United States was, "No matter where I went in America the only thing they talked about was cars." Certainly there were plenty of episodes behind this statement.

On 21 March, just before Foreign Minister Ito's visit to the United States, Ambassador Mansfield made this request of Mr Ito. "This is an instruction from Secretary of State Haig. Could you reduce automobile exports to the level of several years prior to 1980?"

At a conference between Foreign Minister Ito and Secretary of State Haig, Secretary Haig said, "In order to restore military balance with the Soviet Union, a strong America is necessary and we must give priority to passing the new budget in Congress to reduce the size of government."

At a conference between Foreign Minister Ito and President Reagan, the President explained the troubles of the U.S. auto industry and said, "It would be terrible if a protectionist law were passed in the U.S. Congress."

At a conference between Foreign Minister Ito and Treasury Secretary Re n, the secretary said, "A parent wants to see his ugly daughter (meaning Chrysler) married off too, even if it means providing a dowry."

On 27 March, in a meeting between Foreign Minister Ito, Minister of International Trade and Industry Tanaka, Chief Cabinet Secretary Miyazawa, and Mr Okita, a government representative, the foreign minister pointed out that, "This time, there will be no negotiated agreement. The heads of both countries want to settle this matter quickly."

When these statements are put together, a certain scenario takes form.

First, there is a pretense that Japan will unilaterally cooperate on automobiles. The control of auto exports to the United States is left up to the independent decision of Japan. Even when important officials of the American Government come to Japan, they say that their purpose is not negotiations. Ambassador Mansfield's cutback volume request was "not to be leaked to the outside under any circumstances." Mr Ito said, "The American Government is making no specific requests." This was to be a feature of any "discussions."

However, when Japan and the United States discuss cutting auto exports by 200,000 to 300,000 vehicles compared to last year, this does not differ in any way from negotiations. A Foreign Ministry source says the reason for making a point of expressing something this clear as "discussions" rather than "negotiations" is because "it will benefit both countries." This means that the new Reagan government can get by without pulling down its banner of "free trade." If the congressional majority who desire restraints on Japanese autos are appeased, it will be easier to carry out the new administration's measures for economic renewal. At that point, even though it is impossible right now, Japan can cooperate with a "strong America." This is the plot.

However, there is no guarantee that this devotion to the Reagan government will buy off pressure on Japan to share more of the defense burden. Our government leaders must actually feel even more conscious of the defense issue when we are told that the official American view is that defense is not involved.

Even if cars and defense are separate issues, a MITI source says, "When the auto issue is settled, the next problem may be defense." Some point to "one more scenario" on the American side.

Unilateral auto import cutbacks by Japan will result in a number of cost burdens. If the matter is to be largely settled in one blow during April, the government will have to take forceful measures against the industry. The most effective method would be to establish a quota for each manufacturer by invoking an export trade restraining order. However, MITI is not enthusiastic. It says, "It would be a suicidal act for trade administration."

Especially if the coming measures for the United States are based on autonomous decisions with no American demands, the United States will not acknowledge any part in a trade control order. The Japanese Government will have to take full responsibility. Both Canada and Europe will say, "Do the same for us." If there is a great impact on the auto industry it will probably put the blame on MITI. Therefore, a trade control order is a two-edged sword and MITI is desperately trying to find some other way out.

The government needs to consider carefully whether the price that must be paid to the United States balances out with our own country's welfare.

9651
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POLITICAL AND SOCIOLOGICAL

YOUNG FACTION MEMBERS CONTEND FOR LDP LEADERSHIP

Tokyo YOMIURI SHIMBUN in Japanese 2 Mar 81 p 2

[Text] The activities of "new leaders" in the Liberal Democratic Party (LDP), once suppressed by the faction leaders in the interfactional strife, are starting up again. The "early starter group," represented by Noboru Takeshita (former finance minister), is being aggressively pursued by the "late starter group," among them Rokusuke Tanaka (minister for international trade and industry) and Michio Watanabe (finance minister). Joining in the fray is Ganri Yamashita (chairman of the Diet Steering Committee), who may be backed by former Prime Minister Tanaka. This makes the new leadership contest a confusing battle. Former Prime Ministers Fukuda and Tanaka, who still control the LDP factions remain unconcerned, noting, "competition is good." However, along with the two candidates for party president, Nakasone (Director General, Administrative Management Agency) and Komoto (Director General, Economic Planning Agency), who are being closely pressed for the post-Suzuki position, they will never know when the wave of generational change may come upon them.

Pattern of the Confusing Battle

The so-called "early starter group" for the new leadership is made up of the following six: Shintaro Abe (LDP Policy Planning Committee, Fukuda faction), Noboru Takeshita (Tanaka faction), Kiichi Miyazawa (Chief Cabinet Secretary, Suzuki faction), Ichiro Nakagawa (director general of the Science and Technology Agency, Nakagawa faction), Toshiki Kaibu (former minister of education, Komoto faction). As the candidates for Prime Minister in the 1980's, they are competing with each other to demonstrate their prime ministerial caliber.

However, recently, Finance Minister Watanabe (no faction) and Minister for International Trade and Industry (MITI) Tanaka (Suzuki faction) have shown remarkable ability. Furthermore, even Yamashita, on the 21st, the day of his office opening, took the occasion to announce his candidacy for the new leadership. "They have no knowledge nor power as politicians. They are merely blowing the horn, beating the drums and dancing," says an official from the Suzuki faction. Despite this frosty view, the situation appears as if all sorts of flowers have bloomed at once.

Impatience of the Old Guard

A leading figure of the middle of the road opposition commented on the "new leaders": "Abe and Takeshita do not look good. Watanabe, Nakagawa and Tanaka will be making rapid progress." Abe and Takeshita, during last year's intra-party struggle, were involved in the "Generation Change Debate" which sought to remove the existing leadership. It is rumored that they thus provoked Fukuda and Tanaka's anger and are not on good terms with them. However, to this day, this has not shown any outward signs. It seems that Abe has finally quelled the anger of Fukuda and the senior members of the faction. But this is not sufficient reason to call him the "Fukuda faction's Crown Prince."

On the other hand, even though Takeshita appears to be one of the top officials in the "Thursday Club" of the Tanaka faction, a mid-level Diet member from that faction has it that, "unfortunately, he is still hard at work 'mopping the floor' (still has to take orders)." Moreover, Takeshita is under attack from two sides. Kosaka has changed from his independent position and joined the Tanaka faction, while Yamashita has also started his move towards the future.

Miyazawa also is in a difficult position as his ground has been shaken by Tanaka's entry into the battle. Thus, each of the three has much to worry about: Should they plan for the boss handing over power voluntarily or should they aim one day to take power for themselves?

A Separate Troop

Among the early starters, Nagagawa is moving about freely. Though it is small, he has a base of his own, "Jiyu Kakushin Doyu-Kai" ["The Liberal Progressives Group] and is preparing for the battle against the Suzuki-Tanaka coalition as a separate troop from the Fukuda faction. He is planning a publication ceremony in Tokyo on May 15 and is aiming to sell himself as a faction boss. He has the ambition to split off from the Fukuda faction in the future.

Kaibu from the Komoto faction established an office near the Diet at the beginning of this month and is holding seminars with young members of the faction as the main participants. Although this group has not been designated publicly as a policy studies group, it is certain that it aspires to succeed the Komoto faction. "As a separate troop from the Komoto faction, it will devote itself to attacking. We will split the Tanaka faction and unify all the 'new leadership' behind Komoto," says Kaibu in a manner full of fighting spirit that pays no attention to the possibility of accomplishing this.

Endorsement

MITI minister Tanaka explained his organization of the 'Shin-sedai Kenkyu-kai' ['New Generation Study Group'] in this way, "I have Prime Minister Suzuki's approval." Similarly, Yamashita, another of the "late starters" said, "My old man (former Prime Minister Tanaka) encouraged me." Yamashita will be attending rallies in Tokyo April 10 and Osaka April 27, sponsored by head of the Japan Chamber of Commerce Nagano and other business leaders. It is said on

both occasions former Prime Minister Tanaka will be present and will endorse him publicly. This news is upsetting to Takeshita and others.

An Aging, Bureaucratic Society

Nakasone, a strong candidate to succeed Suzuki, comments on the movements of the various candidates for the new leadership as follows. "Policy proposals backed by young leadership gives vitality to the party and is thus good." On the other hand, Komoto, maybe because he holds a monthly "golf meeting" with Abe, Nakagawa, and Tanaka, has made no comment. However, it seems neither of them are calm inside.

Former Prime Minister Fukuda says, "I would like to see young people who are proud to be the champion of pure, right and strong conservative power aggressively take leadership." Former Prime Minister Tanaka says, "I, too, used to run around stealthily trying not to be noticed by Mr Sato's (late former Prime Minister Eisaku Sato) 'fish eyes.' Tanaka faction is the virtual ruling party. It is a matter of course that people with aspirations like Takeshita, Kosaka and Yamashita compete with each other."

Both of them sound very confident. But what would they do if the movement that seeks the change of generation develops into a big surge? "In short, the LDP is about to face an aging generation, where former prime ministers who normally should retire, still refuse to yield their power. Even the new leaders are only walking around dragging their chains in a cage, the cage of factions existing in a bureaucratic society." This comment by a senior non-faction Diet member is beginning to sound reasonable.

9782
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SCIENCE AND TECHNOLOGY

COAL LIQUEFACTION PILOT PLANT USING DIRECT HYDROGENATION

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 56

[Text]

* Mitsui Engineering & Shipbuilding Co., Ltd., in cooperation with Nippon Kokan K.K., Electric Power Development Co., Asahi Chemical Industry Co., and Hitachi Ltd. has decided to construct a coal liquefaction pilot plant of 2.4 tons/day scale. The liquefaction technique to be employed consists of direct hydrogenation, a method taken from the Sun Shine Project of the Ministry of International Trade and Industry. Within the year the construction will be completed for a year-long operation, starting early 1982 followed in spring 1983 by an evaluation task before any subsequent step is taken. If the current plan goes without any operational trouble, a large-scale demonstration plant of 250 tons daily capacity would be built for completion in 1985 aiming at launching in the not too distant future a commercial coal liquefaction plant with a throughput of 25,000 tons/day.

Coal liquefaction by direct hydrogenation is the process whereby coal and hydrogen are hydrogenated and liquefied in one stage at high temperature and pressure, to produce coal liquids, ranging from light to heavy, under varying hydrogenation procedures. The reaction conditions are 400-500°C, 100-300 atms, and the reaction times vary from several to tens of minutes, with all coals but anthracite being suitable. Technically, although the method requires high temperature and pressure, it features a one-stage operation, and boasts efficient hydrogenation as well as products suitable for solid-liquid separation.

CSO: 4120

SCIENCE AND TECHNOLOGY

HIGH ENERGY PHYSICS RESEARCH CENTER'S TRISTAN PROJECT

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 23 Jan 81 p 4

[Text] The next generation is said to be the Age of Elementary Particle Science. In 1981 the High Energy Physics Research Center, located in Tsukuba Research Center City (Director: Tetsuji Nishikawa) will begin implementing a plan for construction of a beam-collision format, high energy particle accelerator--the so-called Tristan Project--with a view to start testing in 1985. The aim of the project is to construct the world's foremost, super-large particle accelerator--960 meters in diameter--and to discover quark--the ultimate elementary particle--by smashing electrons and positrons with the highest beam energy of 25 to 30 billion electron volts; and otherwise explore the various vanguard topics in physics today. Since accelerator science itself is a collection of advanced technologies--super-conduction, electro-magnet, super-high vacuum technology, measurement technology and so on--the industrial world is expecting positive results from the Tristan Project.

Many high energy physicists are hoping for an early realization of the Tristan Project since it is a way to ascertain the intrinsic nature of a material's ultimate structure. The construction for the said project is to be pursued in two stages--first and second. The first project is a 5-year plan beginning in 1981 at the total cost of 75 billion yen under which an injection [nyusha] accumulator ring (approximately 120 meters in diameter) and a Tristan ring (about 960 meters diameter) will be constructed in order to perform elementary particle tests involving collision of electrons and positrons with maximum energy of 25 to 30 billion electron volts.

It is said that if super-conduction, high frequency cavern--currently under development--is used, the above noted energy level may be maximized to 35 to 40 billion electron volts.

According to the plan, an electron is accelerated up to 3 billion volts by means of a linear accelerator (scheduled completion date: 1981) 400 meters in length belonging to the radiation ray testing facility. Then it is kept in the injection accumulator ring and accelerated to 6 billion electron volts, and then put into the Tristan ring. In the meantime, as the positron does not exist in an ordinary substance, the electron is accelerated to 200 million electron volts using a

small linear accelerator and struck into a metal. Positrons thus generated are gathered; and relying on the same procedure used in the case of electrons. It is processed into the injection accumulator ring and then shot into the Tristan ring.

Within the ring the electrons and positrons run in opposite directions at the rate of $\frac{1}{10,000}$ seconds per revolution. In the beginning, their orbits are staggered so they cannot collide. When the line up of electrons and positrons is completed, they are accelerated to the maximum 30 billion electron volts and made to collide head-on.

Since each is accelerated to 30 billion electron volts, when they collide, they do so with the force of 60 billion electron volts. Both electron and positron particles are obliterated and they are separated into minutest constituent parts. Physicists the world over are intensely searching for the quark of the future from among them.

The elementary particle research is said to be the ultimate field in physics. It is expected to have a great ripple effect. But it requires tremendous capital and vast grounds; the size of accelerators range from 2 to 3 kilometers in diameter. At the European International Nuclear Research Laboratory (Geneva, Switzerland) a gigantic monster of an accelerator--10 kilometers in diameter--is being planned.

In order to resolve this question, a collision type accelerator was developed. There are two collision energy research projects--involving maximum of about 40 billion electron volts accelerator--currently in progress. One is in West Germany--"PETRA" and the other is in the United States "PEP." With Tristan, the range can be expanded further to 60 billion electron volts.

The major feature of the Tristan Project is that new technologies and ideas are used everywhere--for example, development of super-conduction, dipolar electromagnet used in super-large positron synchrotron which will be necessary for electron-positron collision experiments in the future.

This particular developmental research is organized by the professorial staff from various research fields. Already, a test conducted toward the end of last year revealed that the super-conduction, dipolar electromagnet for the Number 2 Machine has a capability vastly superior to the world standard. It is said that a 14 centimeters inside diameter coil, 1.2 meters length, niobic titanium super-conduction, dipolar electromagnet has generated 5.25 Tesla highly refined magnetic field at 4.2°K. This is the first time anywhere in the world that a positron synchrotron super-conduction electromagnet with a large coil bore has been able to generate a magnetic field greater than 5 Tesla.

Using this kind of developmental research as a base, the High Energy Research Center is looking toward the development of the "step"--a 13 Tesla class unit--to be made as a U.S.-Japan joint project in 2 to 3 years. With that goal in mind, the Center is prusuing basic research on a new super-conduction line and super-flowage cooling method.

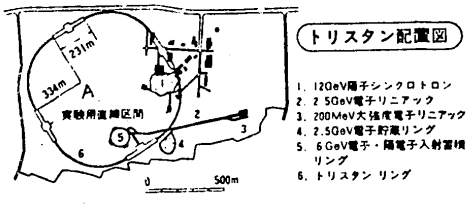
An important key to a successful accelerator system is a superior detector that can measure the direction, speed, energy, momentum, mass and amount of electricity and so on of particles. Development of a new measuring device will be emphasized in the collision type Tristan Project. Development of jet flight pattern

measurement device and research concerning positron's destruction belong in this classification. These will be developed under a 3-year plan which will begin in 1981.

Upon completion of the super-conduction electromagnet development scheduled for around 1985, the High Energy Research Center will launch its Second Project aimed at a construction of a super-conduction positron ring inside the same tunnel as electrons and positrons and beam collision testing of maximum energy 25 billion electron volts electrons and 300 billion electron volts positrons.

Compared to the currently on-going experiments of this nature, the said test's collision energy will be several tens to hundred fold greater. Translated into precise terms used in analyzing and observing particle structure, it would mean 10-16 cm. It is hoped that this experiment will yield detailed information regarding the nature of quark within an elementary particle and even the internal structure of the quark itself.

Tristan Placement Diagram



Key: 1. 120GeV positron synchrotron
2. 2.5GeV electron lineac
3. 200MeV high intensity electron lineac
4. 2.5GeV electron storage ring
5. 6GeV electron/positron injection accumulator ring
6. Tristan ring

A. Experimental Use tangent

11460
CSO: 4105/134

SCIENCE AND TECHNOLOGY

SUPER FINE POWDER TECHNOLOGY OFFERS GREAT POTENTIAL

Tokyo NIHON KEIZAI SHIMBUN in Japanese 19 Jan 81 p 11

[Text] Metal powders called super fine particles have become the center of great attention recently. The collections of super fine particles ranging in diameter from 1/1,000 to 1/10 micron display magnetic properties, internal stresses, light absorption, thermal resistance, and melting point which are so different from those of bulk metals of the same elemental composition as to defy imagination, and there is great potential for some very innovative applications in the areas of electronics, catalytic chemistry, metallurgy, and medicine. At the present time, research in this area in Japan is leading the world, and preparations are under way for this technology to become the nucleus in forthcoming international technological struggles.

It Looks Just Like Soot

"The soot inside a smokestack. That is just what this material looks like." So said a member of the National Research Institute for Metals of the Science and Technology Agency. He opened up a pharmaceutical package of apparently valuable material in the palm of his hand. It was ordinary looking material, just as he had described. There is no metallic luster. It appears black because light is completely absorbed. The individual particles which make up the fine powder are no larger than 1/100 the size of a cholera bacterium and these particles only appear black when seen under an optical microscope. An electron microscope has to be used to differentiate the particles. Some of the smaller particles contain only a dozen or so elementary particles, while the larger members may contain several tens of thousands.

These super fine particles came into the limelight only very recently. While they are simple metals reduced to very fine state, this great reduction in size has been found to be associated with some remarkable properties. Let us list some of the properties which have been discovered thus far.

These particles have very large surface area. When one gram of powder is spread out over a plane, its surface area will be as much as 70 square meters.

A particle has large surface tension, as a result of which there is very large internal pressure. This pressure is of the order of several hundred thousand atmospheres, rivaling that within the earth's interior.

Fine powder of the iron alloy family display much greater magnetic properties than larger masses of the same material.

Fine powder of the chrome family alloys absorb light very well.

The melting point (temperature at which a material melts) is very low compared to bulk metal. For example, the melting point of silver is 960 degrees Celsius, but that of fine silver powder is less than 100 degrees Celsius. In other words, fine silver powder will melt in hot water.

The activity of fine powder is high, and it enters into various types of reactions.

It has almost no thermal resistance at low temperature, and it conducts heat very efficiently.

Many Applications Appear

These properties should give rise to a variety of applications. The area which has been researched most thoroughly at present is in the area of magnetic applications. Use in test development of magnetic tapes is already being researched by Fuji Photo Film, Matsushita Electric Industrial, Hitachi, and Titanium Kogyo and some universities are developing magnetic tapes. There are hopes that tapes with 10 times the recording density of the present tapes may be developed.

Mitsu Toatsu Chemicals has zeroed in on the light-absorbing property to engage in research on infrared-absorbing materials, and applications in the area of solar heat utilization devices are being explored. The enormous surface area and the very high activity are expected to lead to the development of some revolutionary catalysts, and researches are under way at Daido Special Steel and Sagami Central Laboratory.

In addition, fine nickel is used as catalyst for the propellant of a solid fuel rocket, and there have been suggestions that the use of super fine powder might enable the production of rocket fuel with 100 times the combustion efficiency of the present fuels. There is also possibility of great changes taking place in the area of powder metal technology. Materials presently being hot pressed at a temperature of about 1,000 degrees Celsius may be press formed at 100 degrees Celsius or thereabout, enabling a high level of energy conservation.

Some foreign results include the use of fine powder in low thermal resistance heat exchangers and heat transfer materials for very low temperature units, to enable the first attainment in the world of a temperature very close to absolute zero. Super fine particulate magnets have been discovered in the cilia of bacteria, and this presence is being exploited to separate microorganisms with magnets in research now under way.

In the scientific area, attention has been directed at these super fine particles being almost identical with space dust, and these super fine particles may serve to explain some of the states in space.

Now, how does one prepare these super fine particles? Some Japanese researchers predicted some of the singular behavior of these super fine particles about 20 years ago, and basic studies have been continued in the universities.

The New Technology Development Work Group (director, Yoshimitsu Takeyasu) took up the results of these researches and contracted development of production technology to Vacuum Metallurgy (manager, Shuzei Hayashi) in 1971. At present, nearly all the super fine powder used in researches throughout the world was prepared by the equipment developed by Vacuum Metallurgy. At the same time, it is said that Vacuum Metallurgy is the only business enterprise in the world which presently has any equipment for preparing this very fine powder.

The method is called vaporization, in which a container placed within a vacuum has inert gas sealed in beforehand, and metal is heated to high temperature within this container, causing it to vaporize. Metal vaporized in the form of smoke-like metal vapor is recovered as super fine particles.

The problem is the price. The monthly production of the unit which has been developed is only a few kilograms, and the cost of the super fine metal product is about 300,000 yen per kilogram. This is a tremendous barrier to practicalization. It is said that this company is aiming at lowering the cost to a few tens of thousands of yen per kilogram.

New Production Method

In the meantime, the National Research Institute for Metals has developed a new production method which might effect a large reduction in cost, and this method is attracting considerable attention.

Hints were obtained from the dispersion of fine particles from molten metal of an arc-melting process, and a technology embellishing this behavior was developed. The arc is dispersed by directing a stream of argon gas containing more than 30 percent hydrogen. The hydrogen which is dissolved to a supersaturated state in the molten metal is said to disperse super fine particles as it escapes from the melt. "The production capacity is between 100 and 10,000 times greater than the vaporization method," said Director Uda of the First Laboratory, which developed this method.

In any event, Japan is presently leading the world in the two areas of production and application of super fine powder, with its amazing potential capabilities. Japan holds the basic patents, and there is a consensus among the people concerned that this technology should be developed as a solely Japanese technology.

The Science and Technology Agency has taken up this subject as one of the "eyeball projects" for the Creative Science Promotion System it plans to establish in 1981, and it hopes to enlist the aid of industry, government, and academia in establishing the basic technology.

2267

CSO: 4105/120

SCIENCE AND TECHNOLOGY

TECHNICAL COOPERATION, JICA'S CONTRIBUTION DISCUSSED

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 pp 11-16

[Article by Junpei Kato, Director of Planning Department, Japan International Cooperation Agency (JICA)]

[Text]

1. Entire Picture of Japan's Technical Cooperation

Japan's technical cooperation in 1979 in terms of money, amounted to $242 million, which corresponds to 9% of Japan's official development assistance (ODA-$2,637 million), 13% of bilateral ODA ($1,921 million) on 43% of bilateral grant ($560 million).

Technical cooperation from some donor countries accounts for a large part of bilateral ODA (e.g., 57% for France). For Japan, technical cooperation accounts for a relatively small percentage of the total ODA. However, Japan's technical cooperation has for some years been showing high growth, and now is nearly three times the amount of 5 years ago.

Technical cooperation is divided into three sections: 1) students and trainees, 2) experts and volunteers, and 3) equipment, material, and other items. Here, I am going to explain, more in detail, the performance in 1979 of Japan's technical cooperation of the first two sections.

For section 1), in 1979 students numbered 1270, and trainees 7927, the latter far surpassing the former. For the students, those of secondary and undergraduate levels numbered 450 and postgraduate students, 820, the latter surpassing the former.

For section 2), in 1979 experts numbered 5759 and volunteers, 914. These experts included only 342 teachers (6%) and volunteers included only 87 teachers (10%).

In the same category as technical cooperation, Japan greatly differs from other major donor countries (such as France) which sends out teachers extensively, particularly language teachers, and also accepts foreign students.

Thus, unlike other donor countries, Japan's technical cooperation is of little cultural and educational nature, but literally, is cooperation in technical fields. More specifically, Japan's technical cooperation lays emphasis on the following sectors:

Experts and volunteers:	Industry (30%), agriculture (26%), and public utilities (15%).
Trainees:	Industry (47%), agriculture (12%), and public utilities (10%)
Students:	Engineering (26%), agriculture (15%), and natural sciences (11%). (though emphasis here is spreading somewhat).

Now, let us turn to countries to which Japan's cooperation is directed. Because of Japan's geographical position, emphasis naturally, is directed toward Asian countries. In particular, the East Asian countries are important. More than 50% of the students and trainees are from these countries, and 40% of the experts and volunteers are sent to these countries.

Friority countries in this region, namely Korea and five ASEAN countries: Indonesia, Malaysia, Philippines, Singapore and Thailand are particularly important as main recipient countries of Japan's entire technical cooperation and, in addition to those six countries, China's weight is going to increase.

Next to the East Asian areas, Japan's efforts for technical cooperation are directed toward Central and South American area (nearly 20% for both students and trainees, and experts and volunteers). Brazil is equally as important as the East Asian countries because of impressive size of the Japanese colony in that country. Other Latin-American countries to which relatively large amount of technical cooperation is extended are Paraguay and Bolivia.

In other areas, Japan's technical cooperation is provided in Africa (10% for students and trainees, and 20% for experts and volunteers, with greater emphasis toward the latter), South Asia (about 10% for both activities), and West Asia (5–7% for both activities). Technical cooperation is also, increasingly being extended to the Pacific area, though in total amount this is not large because the countries in this area are relatively small.

Countries to which Japan directs relatively large amounts of technical cooperation are: Egypt, Kenya and Tanzania in the African area; Bangladesh, Srilanka, Nepal and Burma in Central and South Asia; and Iraq in West Asia.

2. Japan's Technical Cooperation and JICA's Contribution

Japan's technical cooperation consists of two types: one is purely on a governmental basis, and the other through private bodies, most of the former being carried out by Japan International Cooperation Agency (JICA).

JICA's contribution in 1979 accounted for 66% of all Japan's technical cooperation and as a general trend in recent years, this percentage is increasing though rather slightly.

Among the bodies engaged in technical cooperation other than JICA, the first is the Ministry of Education which takes care of foreign students invited with scholarships being extended to them. There are also a number of private bodies rendering technical cooperation, but here I will mention only two of them.

One is the Japan Overseas Development Corporation. This Corporation is participating in Japan's technical cooperation in addition to other activities: it sends out experts from Japanese companies to give technical guidance at the request of private companies of the developing countries.

Experts sent out by the Corporation are mostly engineers in manufacturing fields. They include many of these who after years' service in partical jobs in private companies in Japan, have had experience in giving technical guidance in companies overseas. They give advice in many different fields from methods of production to management, for companies in the developing countries.

The other group is the Association for Overseas Technical Scholarship (AOTS). The Association was established in 1959 for the purpose of helping Japanese companies in opening branches in other countries, by training local employees from those countries working in the companies' branches. The Association, which has been operative for 20 years, has worked out a unique and very successful method for educating local workers in techniques using the Japanese language.

Although these two associations are private organizations, they are amply subsidized by the Japanese government.

The cooperation rendered by the Ministry of Education and the above two organizations is far smaller than that provided by JICA. By percentage, the Ministry of Education accounts for 7% of all the technical cooperation provided by Japan, the Japan Overseas Development Corporation 1%, and the Association for Overseas Technical Scholarship 4%. From this, it is clear how large JICA's weight has been in Japan's providing technical cooperation and JICA is truly playing a leading role in the programme.

For students and trainees, primarily, the Ministry of Education has taken care of students, while JICA has looked after 3743 (47%) out of the 7927 trainees (in 1979). Other than JICA, AOTS has made a relatively large contribution, taking care of 2791 trainees (30%).

For experts and volunteers, which totalled 6673 in 1979, JICA sent out 3662 experts and 914 volunteers, totalling together 4576 or 69% of all.

The Japan Overseas Development Corporation's technical cooperation, which started only recently, made a rather modest contribution in 1979, sending out 124 experts (2%).

3. Structure and Services of JICA

JICA is an organization established in 1974, run and financed totally by the Government. Its structure and services are provided for under the International Cooperation Agency Law and performs its services under strict governmental control.

JICA is managed by its President, Mr. Keisuke Arita, 2 vice-presidents and 11 executive directors. It has 17 departments and a secretariat of Japan Overseas Cooperation Volunteers which takes care of volunteers being dispatched.

Also, JICA has 7 training centers and affiliated organs which accept trainees from abroad, as well as other affiliated organs, and 9 branch offices within the country. It also has a number of overseas offices abroad, mostly in the developing countries.

JICA's services are not confined to technical cooperation. It also provides emigration services, supply of funds and other related services, yet, its main duty is technical cooperation. So I will limit the explanation of its services here to technical cooperation, which largely includes the following: a) sending of Japanese field service personnel to developing countries (dispatch of experts, survey missions and volunteers); b) training; c) supply of equipment and d) project-type technical cooperation.

a) Sending of Japanese field service personnel to developing countries (dispatch of experts, survey missions and volunteers): – This includes three types of services. First, sendingof experts (mostly technical experts as mentioned earlier) such as advisers to the government or as technical trainers in governmental training organs. These experts stay in the developing countries and work to transfer and transplant techniques in those countries.

Secondly, sending of survey missions. JICA dispatches missions consisting of technical experts to make surveys useful for economic development in developing countries.

Thirdly, the dispatch of Japanese overseas field service volunteers. These volunteers are youths having some technical knowledge and who work hard to pass on their knowledge in the severe environment of the developing countries.

Japanese field service personnel are usually sent to developing countries upon request made by the governments of those countries. They are sent in order to fill the technical vacuum in the field most needed by recipient countries.

b) Training includes group training and individual training: – For the former, nearly standard training courses are prepared every year and trainees are invited to attend them from the developing countries. For the latter, special training courses are organized at the request of the governments of particular developing countries. Because it is expensive and requires a lot of effort, this latter service is rendered only in special cases, mostly in those where particular training is needed for counterparts working with Japanese experts in the framework of Japan's technical cooperation.

c) Supply of equipment consists of donating necessary equipment when experts are sent out to countries for technical cooperation, and after trainees have finished training in Japan and return home. Through this materials and equipment are provided to enable the transfer of particular techniques efficiently, at the request of the countries concerned.

The provision of services a), b) and c) above combined, comes under the so-called project-type technical cooperation.

In practice, this service consists of a rather complex form of cooperation beginning with the sending of a survey mission to the site at the request of a developing country, to find out what cooperation can be rendered effectively and when details of cooperation are determined, sending out experts generally for 3--5 years, supplying materials, and training counterparts in Japan.

At present, JICA maintains 109 projects over a wide range of fields including agriculture, stockbreeding, fisheries, forestry, mining, small industries, telecommunications, vocational training, medical services, public hygiene, family planning, etc. The developing countries to which project-type cooperation is being rendered, include many of the Asian countries, and some countries in the Middle East, Africa, and Central and South America.

This project-type technical cooperation is provided upon request made by governments of developing countries and thus is directed to the field in which systematic input of the techniques is most needed. JICA is endeavoring to implement technical cooperation projects efficiently and to make them fit for local conditions and needs of the recipient countries.

4. Features of JICA's Technical Cooperation

The first feature of JICA's technical cooperation is the fact that it has no element of continuation from Japan's colonial past.

Japan had an unhappy experience of colonial rule in some Asian areas, such as in the peninsula of Korea and the island of Formosa. But JICA does not have any staff who have been previously involved in Japan's colonial administration, and Japan's post-war technical cooperation is entirely free from any such past colonial experience.

This is in sharp contrast to other donor countries previously having colonies, which started their "assistance", particularly technical cooperation after the Second World War as an extention of their colonial administration.

Examples of this, are shown by France and Britain. They transformed their former offices of colonial administration into "assistance" rendering agencies, which largely include officials formerly experienced in colonial administration, who in turn are sent as experts in technical cooperation to developing countries or are engaged in the planning of technical cooperation.

The same also applies to international organs. It is a well-known fact that the staff of the World Bank which took the lead in creating "development assistance policies" in the post-war world, largely included officials of earlier colonial administrative services.

As a result of definite isolation from the colonial past in performing its services, JICA is at a handicap. Technical cooperation rendered by France and Britain is based on a huge amount of knowledge and experience accumulated in colonial times about the economy, society, environment and produce of their previous colonies. A number of research agencies established to facilitate colonial administration, are still performing their functions and are directly or indirectly related to technical cooperation.

In contrast, Japan has no such accumulation of information from the past. Japan's technical cooperation has had to start from scratch. Thus, JICA's knowledge and experience about developing countries is very limited, compared with the corresponding organizations of the once colonial powers. Instead, JICA tends to consider problem of developing countries, with the eyes totally free from prejudices often held by former colonial administrators, to be the problems facing newly independent states.

Another feature of JICA's technical cooperation is its laying emphasis on the transfer of techniques, as is explained in relation to the entire picture of Japan's technical cooperation.

As I mentioned earlier, in the domestic section of Japan's technical cooperation, trainees (mostly in technical fields) far surpass students in number (both were at the ratio of 6:1 in 1979). For other donor countries, this ratio was 1:1.4 (1977) for France or 1:2.1 (1978) for Britain, with students outnumbering trainees, except for Germany 5:1 (1978).

Also, in respect of the sending of experts, the percentage of educational experts including teachers has been very low – 6% in 1979 – for Japan. This percentage was far higher for other donor countries: 63% (1978) for Germany, 80% (1977) for France and 45% (1978) for Britain.

As indicated, Japan's technical cooperation lays emphasis simply on the transfer of techniques to the peoples of developing countries. Not only visiting students but also teachers sent out are mostly in the field of science or engineering. Thus, one might say that most of Japan's technical cooperation is purely technical.

As is well known, Japan has imported science and technology from Western countries in the past. Japan felt bitterly inferior to the Western World because of lacking such science and technology when Japan opened her country to the world the middle of 19th century. For over a century thereafter, Japan has been making utmost efforts to import foreign science and technology to be established in her environment. The results are just as one sees them.

Thus, from such experience, the Japanese believe that the successful transplantation of science and technology is the key to economic development.

At the same time, they realize how difficult this transplantation is.

Here, let me take the example of the establishment of a steel works in Japan. A steel factory designed by British engineers was first completed in 1880 but soon after it ran into difficulties and was closed. The first comprehensive steel works was completed in 1901. This steel works, which had also been designed by foreigners, this time Germans, also ran into trouble and was closed with a year. It was not until after a further five years that techniques best suited to Japan were devised by a Japanese engineer, enabling the steel works to start operation.

From similar experiences, the Japanese know that transplantation of technology will never succeed if it is simply an imitation of foreign technology. They know that it is essential to provide a process for native engineers, who are familiar with the situation of the country, not foreign engineers, to master foreign technology and transform it suitably for local conditions.

JICA's technical cooperation is based on this line of thought and is carried out with awareness of the need for fostering the ability of the people of developing countries to develop their own technology, so that they can create their own technology best suited to their country's conditions.

The third feature of JICA's technical cooperation is related to ways Japanese engineers think and behave. As described earlier, Japan's technical cooperation consists mainly of the transfer of techniques, and thus is strongly influenced by what Japanese engineers think and how they behave.
the European system of engineers taking charge of designing only, and leaving actual operation to be performed by operators (workers) was not adopted. [as printed]

In Japan, engineers are required not only to design but also to participate in trial manufacture and operation. They take pride in their ability to work with workers, whom they lead in practical work. In Japanese factories, all people, from ordinary workers to factory managers (occasionally even the president of the company, as is observed at Sony and Honda) are proud of wearing overalls and working together on greasy machines.

In other words, then is no clear distinction between engineers and skilled workers: Engineers who sit at desks and keep their hands clean are not considered good engineers in Japan.

Sent to developing countries, Japanese engineers become critical of the privilege-consciousness of engineers of the developing countries and their lack of practical ability. Some engineers in developing countries feel that it is mean to work [as printed]

When European technology was first introduced into Japan, physically and to get their hands dirty, with this consciousness definitely preventing them from acquiring any practical sense.

Generally speaking, Japanese engineers are poor at foreign languages, and this shortcoming may have something to do with their tendency to evaluate practical work more than desk work. In developing countries, they try to communicate with local engineers (counterparts) not through verbal explanation but through physical work. If their counterparts refuse to participate, communication becomes difficult.

Another characteristic of Japanese engineers is their devotion to, and their earnestness in the work which they are assigned to accomplish.

When they are sent to a developing country for technical cooperation their duty is to help people of the country.

Thus, they work enthusiastically trying their best to transplant the techniques they have in the country to which they have been sent. They believe that just like past Japan, it is very natural for a developing country today which introduces foreign technology, to make efforts to liberate itself from technological dependency on foreign countries, by modifying the foreign technology introduced to suit its own conditions and by transforming it into technology easy for its own people to handle.

Japanese engineers often complain about the intellectuals of developing countries who have studied in European or American universities, and who have greater affection toward and pride in the countries where they stayed to study rather than they have toward their own country.

They are not happy when they hear intellectuals of developing countries speak proudly of having studied at overseas universities, or notice them to have more interest in and knowledge about the cultures and histories of former colonial states, rather than in and about their own country. Japanese engineers try to work hard for the country to which they have been sent, and they feel that the intellectuals and elite of the country should be proud of their own country, and should devote themselves to the development of their country, thus improving the living standard of their compatriots.

Disappointed sometimes by the intellectuals and elite of the developing countries, who seem to have been too much influenced by Western cultures, Japanese engineers often familiarize with workers and farmers and find among them true nationalists who work silently while developing useful original ideas and acquiring techniques ready to settle conditions of their countries.

Japan's technical cooperation is most efficiently implemented when Japanese experts sent to developing countries can work hand-in-hand with nationally-minded counterparts devoted to the cause of their own country's development.

5. Problems Confronting JICA

For years since its establishment, JICA has been making great strides in expanding its services. In these 6 years, experts sent out and trainees invited to Japan have increased rapidly from 1497 (1974) to 3662 (1979) and from 2169 (1974) to 3743 (1979) respectively.

JICA's budget has also increased, more than doubled, from ¥26.9 billion for the 1974/75 fiscal year to ¥62.8 billion for the 1980/81 fiscal year.

JICA now tackles new problems which did not exist when it was first established. One is technical cooperation with China.

Technical cooperation with China was started in 1979 when China changed its economic policy. At first, it began with a so-called "technical exchange" on equal-to-equal basis in the field of railways. Subsequently it extended to other fields as China enthusiastically came to accept economic cooperation from capitalistic countries. And at present, China is a considerably important country among others to which Japan's technical cooperation is rendered.

China and Japan have in common the culture of Chinese characters. People in both countries use a considerable number of common technical terms. Chinese are intensifying their study of the Japanese language, so as to use technical cooperation from Japan effectively, while there are a large number of Japanese engineers who wish to work in China because of the cultural links they feel with China. Thus, China is a relatively easy country for Japan to provide with technical cooperation.

For this reason, technical cooperation with China is likely to increase rapidly if China wants it. However, JICA takes care not to allow the increasing technical cooperation with China to have any ill effect on the technical cooperation provided to other countries.

Another problem is technical cooperation with the oil-producing Arab countries. As their economic scale grows with increases in income from oil, oil-producing Arab countries are beginning to make strong requests for technical cooperation to be supplied by Japan. Rich with foreign currencies, they have expressed their wishes to invite at their own expense technical personnel from Japan.

However, these countries differ much from Japan in many ways, beginning with culture and climate, which are difficult for Japanese experts to adjust. Thus, JICA is making efforts to improve the basic conditions, such as housing, health care, etc., to enable Japanese experts to work with ease in these countries.

These are problems newly arising but there is a greater and more serious problem confronting JICA. That is the problem of how to cope with rapidly increasing work load.

It is not true that sufficient systems for processing work have been provided to cope with too rapidly increasing work load since the establishment of JICA. JICA's staff has remained the same in size and rationalization of work carried out to process the increasing work load has not been satisfactory.

The number of trainees has been increasing more rapidly than the building of sufficient lodging facilities. Thus, a lot of trainees have been obliged to stay in commercial hotels, complaining about poor hotel services which cannot match those at specially provided lodgings.

Pressed with increasing work, the staff of JICA has had little time to think, making plans hastily often leading to misunderstandings. If things go on this way, Japan's technical cooperation can not maintain the quality of the past.

At this moment, we have to basically review JICA's systems for processing work for technical cooperation and start efforts at rationalization. It seems, such efforts can be two ways.

In one way, since the main service of JICA is technical cooperation and this technical cooperation is mainly rendered in technical fields, JICA itself has to be equipped with technical abilities. JICA has to take on itself to understand the characteristics of Japanese technology and study how well to transplant it in the soils of the developing countries.

In the another way, JICA has to invest more effort in training persons who will be sent abroad as experts.

These who will be sent abroad have to be capable of minimum necessary communication. It is desirable for Japanese experts to know, in addition to English, some of the languages of the developing countries, with which they can communicate directly with local people in the country where they work.

Also, they are desired to become to some extent familiar with the ways in which people live in developing countries, and the differences between Japanese technology and the technologies of developing countries, before they are sent abroad as experts. It is almost essential to have a certain number of trained experts who are familiar with the above and well prepared to work in developing countries in order to further promote Japan's technical cooperation in the future.

These are difficult tasks which cannot be accomplished effectively in a short period. However, there will be no way to maintain the quality of Japan's future technical cooperation without JICA's tackling these tasks today.

CSO: 4120

SCIENCE AND TECHNOLOGY

RECENT RESEARCH, DEVELOPMENT OF ELECTRONIC PARTS, DEVICES REPORTED

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 pp 17-25

[Article by Taiji Tsuruoka, Researcher, Oki Electric Industry Co., Ltd]

[Text]

1. Introduction

Of the many electronic parts and devices now available, very large scale integrated circuits (VLSI) are now receiving the most attention. VLSIs were developed for large capacity memories for electronic computers, and the MOS memory is now playing the leading role. Mass production of 64K-byte MOS memory devices K bit began in 1980 as an early stage VLSI, and such devices are now used in commercial computers. Further, 256K-byte RAM has also been developed.

These increases of integration density are largely indebted to improvements in devices and circuits and to the development of microprocessing techniques, among which the sub-micron lithography technique is currently the most popular. This technique uses electron-beam drawing needed to develop VLSIs.

Research on higher speed operation of semiconductor devices is increasing because commercial devices are reaching the limit of their operational speeds.

Magnetic bubble memory is a non-volatile, rewritable large capacity file memory. One megabyte and 256K-byte versions have already been developed. For example, the 256K-byte type is used as a high speed auxiliary memory in NTT (Nippon Telegraph and Telephone Public Corporation) electronic switching systems.

New memory devices are constantly being developed, such as contiguous disk for the next generation computer and a dual conductor device that shortens access time.

Development of GaInAsP/InP semiconductor lasers in the 1.5 μm (micrometer) band are very active for long distance optical fiber communication. To build a semiconductor laser, new methods of crystal growth, such as MOCVD and MBE, are being investigated instead of the ordinary LPE method.

The electronic devices mentioned above are representative of the industrial products of Japan in the 1980s, and there is no doubt that Japan will continue as a world leader in the production of electronic parts and devices.

2. Estimate of the Production of Electronic Parts and Devices

The recently published booklet by the Association for Promotion of Electronic Industry of Japan, entitled "Long Period Estimate of the Electronic Industry", states that the export of electronic parts and devices will continue to increase corresponding to increased demand from abroad because of the expanding Japanese manufacturing facilities in foreign countries. The domestic production of electronic parts and devices is also expected to increase rapidly.

As shown in the estimate of electronic device production in Fig. 1. the annual growth rates for general purpose electronic parts in the coming ten years are predicted to be 5.9% for capacitors, 6.0% for transformers, and 5.3% for resistors.

IC will form the basis of the future electronics industry. Their cost will decrease at an annual rate of 8%, and their production will increase at a rate of 17.7%/year in 1980–1985 and 17%/year in 1985–1990. The total value of the ICs produced will be ¥880.6 billion in 1985 and ¥1,929.1 billion in 1990. The rapid growth of the IC industry will be derived from the development of VLSIs in the 1980s. For example, the investment in manufacturing processes in the semiconductor industry in Japan in 1980 is about ¥140 billion for the top ten companies alone, and the total investment is about ¥200 billion.

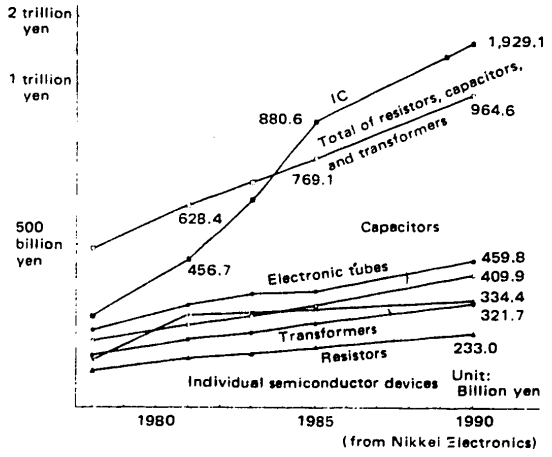


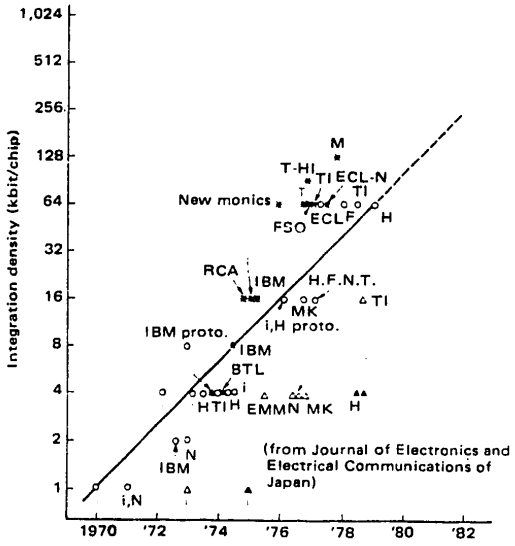
Fig. 1. Estimated Production of Electronic Parts and Devices

3. LSI

3-1. Present Status and Future Trend for Device Development

3-1-1. MOS memory

Because MOS transistors have planar functions, the further miniaturization of patterns attained by recent progress in processing techniques results in an increased density of integration as shown in Fig. 2. In 1980 NTI developed a 256K-byte dynamic RAM by using the EB direct exposure and dry process, and NTIS also announced the same type of RAM as seen from Table 1. Further, a high speed 4K-byte static RAM with an access time of 35 ns has also been developed.



Note (1)

Abbreviations	Enterprises	F	Fujitsu
i	Intel	T	Toshiba
MK	Mostek	M	Mitsubishi
FSC	Fairchild		
EMM	Electronic memories	Note (2) Marks	Types of memory
ECL	Electrical Communication Laboratories, NTT	○	NMOS dynamic RAM
		△	NMOS static RAM
		▲	CMOS statis RAM
H	Hitachi	•	CCD memory
N	NEC (Nippon Electric Company)		

Fig. 2. Annual Progress in the Integration Density of MOS Memory

(1) RAM

(a) Dynamic RAM

Of the various types of ICs, dynamic RAM has the highest density of integration, and this density has quadrupled in the last two years. In 1981 almost all IC manufacturers in the world will begin mass production of 64K-byte, and in 1983 the cost per bit of 64K-byte RAM will probably be less than that of 16K-byte RAM.

(b) Static RAM

i) NMOS

The memory capacity of NMOS is increasing at a rate double that of two years.

Fujitsu and NTT have recently developed a high speed NOMS with an access time of 26 ns by using 3 micron MO gates.

ii) CMOS

Toshiba and Hitachi have developed a 2K-byte CMOS with access times of 95 ns and 74 ns, respectively, using bulk Si wafers.

(2) ROM

(a) Mask ROM

NTT has succeeded in building a 128K-byte N-channel ROM using the electron beam exposure method. Therefore, customizing masked ROMs is easily done by merely changing the software controling the electron beam scanning. This permits small scale production of many kinds of ROM to be possible. And, further, it has been possible to decrease the cell area because this method of writing data controls the thickness of the insulating layer of the gate.

Table 1. High Density MOS Devices Available as of 1980

Device	Maker	Chip area	Cell area (micrometer^2)	Design rule (micrometer)	Thickness of oxide layer (gate) (Å)	Depth of junction (source drain) (micrometer)	Comments
16K HCMOS static RAM	Hitachi	4.76 x 5.5mm	28 x 32	3 ~ 4	-	0.5	
16K CMOS static RAM	Toshiba	5.06 x 5.77mm	33.x 34	2.4 (L) 2.0 (contact)	700	0.7 (p^+) 0.4 (n^+)	
64K dynamic RAM	Hitachi	25.8mm	8 x 18	3.0	400		Si gate NMOS (double polystructure)
64K static RAM	Matsushita	5.44 x 5.80mm	16 x 19	2.0 (minimum)	400	0.5 (p^+) B 0.4 (n^+) As	NMOS/CMOS double polystructure (poly-silicon resistance)
256K dynamic RAM	NTIS	4.84 x 8.59mm	5.7 x 12.5	2.0 (L) 2.5 (Al) (5 bit) 1.5 (contact)	400	0.25 (II)	Si gate NMOS (double polystructure) dryetching
256K dynamic RAM	NTI	5.83 x 8.90mm	8.05 x 8.60	1.0 (poly) (bit line) 2.0 (Mo) (word line) 1.2 (L_{eff}) poly-gate 1.5 (L_{eff}) Mo-gate	400 (poly-gate) 400 (Mo-gate)	0.25 (II)	EB direct exposure Dry process NMOS (poly-gate, Mo-gate)

(b) EPROM

EPROM which appeared as a convenient memory for debugging programs for microprocessors, will continue to increase at an annual rate of 20% in the world market. Dynamic RAM is the only memory with a faster rate of increase.

In Japan, mass production of the EPROMs began in 1979, and now 80% of all EPROMs on the market in Japan are made in Japan. Memory capacity has increased from 16K-bytes to 32K-bytes and new 16K-byte EEPROMs (electrically erasable PROMs) that can directly replace ordinary UV erasable type EPROMs are now on the market.

3-1-2. Bipolar Memory

Bipolar memory has higher speed and lower power consumption than conventional memory, and great efforts are devoted to developing ECL (Emitter Cathode Logic) and IIL (Injection Integrated Logic) rather than to improving the characteristics of TTL (Transistor Transistor Logic). At present most bipolar memories are ECL, and IIL is used as memory cells. Fig. 3 shows the annual decrease in access time of bipolar RAM. The main type of RAM used today is 4K-byte static RAM with an access time of 10 to 20 ns. A higher speed type of 650 mW with an access time of 6 ns has recently been developed.

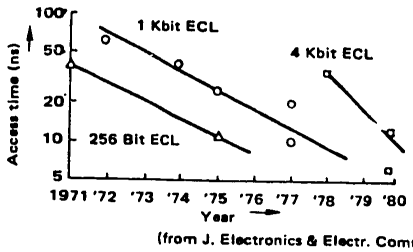
3-1-3. Estimate of Increasing Integration Density

Because higher density of integration is limited by the circuit design, microprocessing and chip area will play dominant roles in increasing integration density, and the rate of increased integration density will change only slowly in the near future. But, as seen from Fig. 4, the relationship between the pattern dimensions and the integration density suggest that a density of about a hundred times more than the present is the upper limit. Microprocessing techniques will contribute largely to increasing integration density.

3-2. Logic LSI

As seen from Fig. 5, MOS has a high density of integration of about 10,000 gates, whereas bipolar has a maximum of 2,000 to 3,000 gates. However, bipolar types have a delay time one tenth shorter than MOS types. Therefore, there are trade-offs in integration and speed in selecting either one.

At present, microcomputer chips have 30,000 to 40,000 elements per chip and have a minimum operation time of 250 ns. With the coming of VLSIs, however, this is expected to increase to 80,000 to 100,000 elements and a speed of 50 ns. (Table 2) When this occurs, it will be quickly followed by a 32-bit microcomputer.



(from J. Electronics & Electr. Comm. Japan)

Fig. 3. Annual Change in Access Time of Bipolar RAM

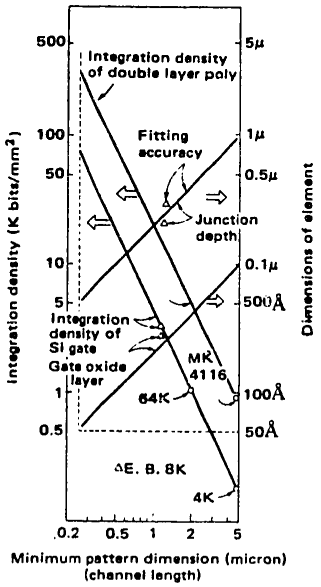
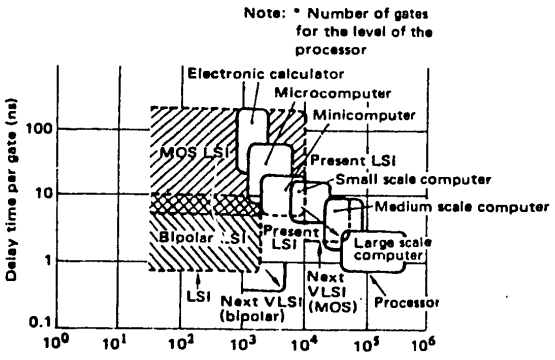


Fig. 4. Integration Density Versus Minimum Pattern Dimension



(from the Monthly Report of Electronic Industry)

Fig. 5. Relationship between LSIs and Various Computers

Table 2. Estimate of Future Development of Microcomputers

Year	1980	1981–1983	1984–1986
Number of elements per chip	30,000 ≀ 40,000	50,000 ≀ 80,000	80,000 ≀ 120,000
Minimum linewidth	3μm	2μm	~1μm
Minimum execution time for operation	250ns	100ns	50ns

(from Monthly Report of Electronic Industry)

Table 3. Outline of VL-R-2 Characteristics (from Denshi Zairyo)

Base plate	4 inch wafer, 5 inch mask
Maximum drawing area	105 x 124mm
Minimum linewidth	0.5μm 1.0μm
Minimum address	0.125μm 0.25μm
Scanning width	250μm
Drawing frequency	30MHz/40MHz
Maximum beam dimension	4μm
Beam current density	50A/cm^2
Accelerating voltage	20kV
Drawing accuracy of patterns	Less than 0.2μm
Registration accuracy	Less than 0.2μm
Maximum drawing speed	100mm□/12 min
Input data form	MANN#3000, CALMA
Main functions	White-to-black inversion, expansion/reduction, mirror

Table 4. Outline of Characteristics of VL-F1, Field Emission Electron Gun Type Electron Beam Drawing Apparatus

Items	Characteristics
Drawing system	Vector scanning and step & repeat drawing
Type of drawing	Direct drawing on wafer
Drawing area	Less than 3 inch wafer
Deflection area	2mm square to 5mm square
Deflection control	High speed high precision correction type 16 bit D-A converter
Resolution of deflecting position	0.03 micrometer (2mm square field)
Generating function of patterns	Figure and straight line generating method
Linear scanning speed	1m/sec to 1mm/sec
Types of drawing patterns	Rectangular, trapezoid, triangle, straight line, point
Distortion correction function	Automatic correction of amplitude term, rotation term, trapezoid term, and shift term by mark detection method, and off-line higher order term correction
Accuracy of detecting mark position	0.01 micrometer (detection of reflected electrons)
Registration accuracy	Less than 0.1 micrometer
Method of moving the sample stage	Step and repeat method by pulse motor
Accuracy of detecting for sample stage position	0.01μm
Input data form	P/G3000 and data for design
Processing functions of drawing patterns	Division of field, expansion, reduction white-to-black inversion, mirror inversion, and etc.

This device can draw patterns with a minimum linewidth less than 0.5 micrometer with an accuracy of less than 0.1 micrometer by using a high speed, high precision, correction type, 16-bit D-A converter and a field emission type electron gun that can feed a maximum of 40nA to a spot with a radius of less than 0.1 micrometer.

3-3. Processing Techniques

One way to increase the integration density of semiconductor ICs is to diminish the dimensions of the unit elements, that is, the microprocessing technique. The Ministry of International Trade and Industry (MITI) has established a cooperative research laboratory for the development of VLSIs, and the Laboratory has successfully developed microprocessing techniques during the years 1976 to 1980. The results are described as follows:

3-3-1. Electron Beam Drawing

Two high speed electron beam drawing apparatus, VL-R2 (Table 3), and VL-S2, have been developed. These are using luster scanning and vector scanning methods respectively, and the cathodes of both apparatuses are LaB_6. It is possible to draw line widths of 0.5 to several microns. Patterns of one

micron linewidth on a 100 mm(φ) wafer can be drawn within10 minutes.

Further, a new electron beam drawing apparatus, VL-F1, with a field emission type electron gun, has been developed (Table 4). This apparatus is a vector scanning type that feeds a large current to a small spot of about 0.1 microns, and therefore, it is possible to use a resist with high resolution and low sensitivity.

Table 5 and Fig. 7 show the development of a new software system "AMDES" for electron beam drawing. To correct the contiguous effect, this system uses various methods to change the scanning speed of the electron beam for each figure, correcting the figures beforehand, and radiating the spot beam for correction. Besides the above mentioned corrections, it is possible to correct pattern distortion caused by warped wafers.

3-3-2. Transferring

The two types of step and repeat projection type exposure apparatus, VL-SR1 and VL-SR2, shown in Table 6, are equal size projection printing apparatuses (minimum linewidth 2 microns and at a speed of more than 30 sheets per hour) and reduced scale projection printing apparatus (minimum linewidth 1 micron and high precision step align mechanism of less than 0.3 microns) respectively.

Reflective projection type far-ultraviolet exposure apparatus, VL-MR1, shown in Table 7, has resolution of 1 micron by using Deep UV of 0.2 to 0.26 microns and reflection type optical system, and can handle 60 sheets per hour for 5-inch wafers.

The experimental electron beam equal size transfer method (Fig. 8) using a photoemittor has achieved a high resolution of less than 0.5 microns and a speed of less than 1 second per sheet (Table 8).

The electron beam reduced scale transfer method has an accuracy of ±0.2 microns for a pattern with a minimum linewidth of 0.5 microns, and thus has resolved stencil problems caused by dividing one pattern onto two masks.

Table 5. Functions of AMDES, New Software System for Electron Beam Drawing

Input processing	Design data Pattern generation data
Correction processing	Contiguous effect correction Deflection distortion correction of electron beam Warpage correction of wafers
Pattern processing	Exclusion of multiexposure Positive-to-negative inversion Division of fields
Output processing	Data for various types of electron beam drawing devices

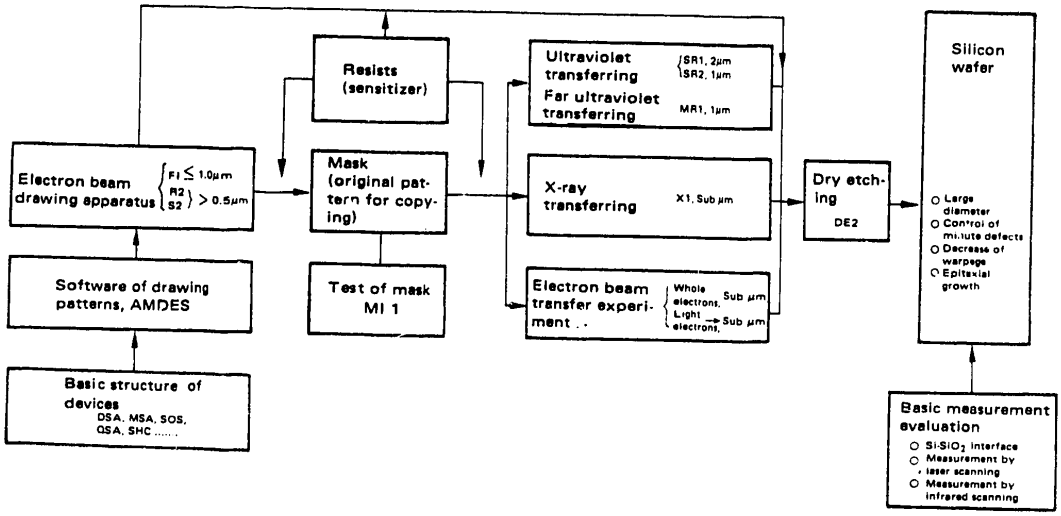


Fig. 6. Outlines of Basic Common Techniques Developed by the VLSI Cooperative Laboratory

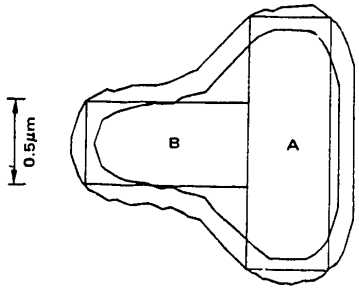


Fig. 7. (a) Computer Simulation of Ordinary Electron Beam Drawing

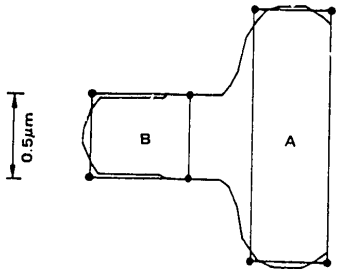


Fig. 7. (b) Computer Simulation of Electron Beam Drawing Using AMDES

In case (a), the pattern becomes round at the edges of the T character, and the exposure becomes large at the boundary region between A and B. (b) shows the method of correction, in which spot beams for correction are radiated at the filled circle positions. The electron beams are radiated with the fiture B partly omitted.

Table 6. Characteristics of Projection Printing Devices

Items	Specification of reduced size projection printing equipment	Specification of reduced size projection printing equipment
Mask size	2 inches square or 2.5 inches square	4 inches square or 5 inches square
Possible wafer size for printing	50mmφ, 75mmφ, 100mmφ	50mmφ, 75mmφ, 100mmφ
Optical system for projection	Equal size, 30mm square screen	1/10 reduction, 10mm square screen, auto-focusing
Resolution of projecting lens	2 micrometers	1 micrometers
Automatic wafer feed mechanism	Attached	Attached
Step and repeat mechanism	Can be set for 1 step, 4 steps, 7 steps, or 9 steps	Arbitrary steps can be selected, step system corresponding to the roundness of the wafer
Step speed	Less than 2.5 sec/step	Less than 2 sec/step
Automatic alignment system	Every step alignment system	Initial alignment system, step alignment possible
Accuracy of automatic alignment	0.3 micrometers	0.3 micrometers
Automatic exposure control	Error less than 2%	Error less than 2%

Table 7. Characteristics of Far Ultraviolet Exposure Apparatus

Items	Specifications
Mask size	4 inches square, 5 inches square or 6 inches square
Possible wafer size for printing	75mmφ, 100mmφ, 125mmφ
Optical system for projection	Equal size Reflective projection type
Wave length	200 to 260mm (far ultraviolet)
Resolution	1 micrometer (far ultraviolet specification)
Automatic wafer feed mechanism	Attachable (optional)
Exposure system	Slit scan system with 1.5mm width
Scanning speed	12.5mm/sec to 1.25mm/sec
Scanning ununiformity	Less than 1%
Alignment system	Automatic alignment system (optional) Manual alignment system
Accuracy of alignment	0.3 micrometer (automatic system)
Automatic exposure control	Error less than 2%

Table 8. Specifications of Experimental Equipment

Items	Specifications
Mask size (mm)	100φ
Wafer size (mm)	75φ, 100φ
Accelerating voltage (kW)	$\leqq$ 20
Mask-to-wafer separation (mm)	10, 7.5, 5
Magnetic field strength (KG)	$\leqq$ 3
Photoelectric surface	CsI
Light source	Low pressure mercury arc
Resolution (micrometer)	$<$ 0.5
Transfer time (sec)	$<$ 1

Table 9. Characteristics of Resist Developed by the VLSI Cooperative Laboratory

Resist	Sensitivity	Resolution	Heat resistance
CP-3	4×10^{-7} coulomb/cm^2	0.3 micron	@
EBR-9	8×10^{-7} coulomb/cm^2	0.1 micron	○
PMMA (IBM)	500×10^{-7} coulomb/cm^2	0.1 micron	△

Table 10. Characteristics of Electron Beam Resist Developed by Laboratories Other Than the VLSI Coop. Lab.

	Abbreviations	Sensitivities (μC/cm^2)	Gamma values	Glass transition temperature (°C)	Thermal decomposition temperature (°C)	Developing laboratories
Positive type resist	FPM CMR	1.5 8	2.4	101	250	VLSI Coop. Lab. Fujitsu
Negative type resist	PGMA SEL-N CMS	0.40 0.40 0.25	2.0 1.0 1.3	78	250	Hitachi NEC-Somei VLSI Coop. Lab.

3-3-3. Resist

Two types of electron beam resist have been developed as shown in Table 9. One of them, CP-3, has excellent heat-resistance properties and high sensitivity ($S = 4 \times 10^{-7} c/cm^2$), and the other, EBR-9, has high resolution of less than 0.1 microns and high sensitivity. Both resists have excellent dryetching-resistant properties. Other types of resist that were developed in other laboratories, except the VLSI Cooperative Laboratory, are shown in Table 10.

3-3-4. Other Results

As shown in Fig. 9, SHC RAM (Stacked High Capacitor RAM) which is the foundation of the VLSI dynamic memory, has been developed by combining QSA transistors and micro-area tantalum-oxide capacitors at a high density of integration. The decrease in memory cell area shown in Fig. 10 contributes considerably to the increase in integration density.

3-3-5. Future Trend

Lithography is expected to shift from UV exposure to mask preparation by EB, and then to the Deep UV transfer method. The appearance of step and repeat reduced projection, however, may outweight any advantages of the Deep UV method. This is because the reduced projection exposure method can be applied to ordinary resist, whereas the Deep UV method must use a new resist, such as the electron beam type, and further, there are no high sensitivity positive resists available at present. The current

technique is shifting toward mask preparation by EB and transferring by reduced projection, and so patterns with linewidths of 1–2 microns will be achieved by the UV transfer method. Thus, direct drawing by EB will become dominant in the submicron age within a few years.

4. Josephson Device

The Josephson junction, which is a switching element of low power consumption and high speed, is expected to be applied to digital devices for high speed computers.

In foreign countries, logic gates and memory cells for high speed computers, and digital devices for peripheral units are being developed by IBM.

In Japan, Josephson ICs are being researched using lead alloy as a superconducting material. To date, trial experiments of four step OR gates of 0.9 fJ and 4-bit nondestructive single magnetic flux quantum memory have been successful.

4-1. Magnetic Flux Quantum Memory

In fabricating a Josephson junction, a tunneling oxide layer a few nm thick must be formed with a good reproducibility and uniformity. NTT has developed a technique that limits variations in tunneling resistance to less than 20% for Run-to-Run, and 10% among 32 mmϕ wafers. To build integrated circuits, earch area structures by Nb/SiO_2 lamination for separating elements and for forming traces, and multilayer wiring structure by SiO interlayer insulation, have been developed. Thus, thin-film resistance of $Au_{1-x}In_x$ ($x = 0.1$ to 0.2) that has a sheet resistance more than ten times that of the compound thin film $AuIn_2$ is now possible.

4-2. High Mobility GaAs FET at 77°K

Fujitsu had developed a new FET that controls the electrons on the GaAs side by using the gate field. These electrons are generated by contacting nondoped GaAs will n-type AlGaAs. Because the elctrons at 77°K have a high mobility of 37,800 cm^2/volt.sec., this device is expected to be used for high speed functions. Electrons transit without being disturbed by impurity scattering, because the donor impurities are collected at the AlGaAs side and the donor electrons are collected at the GaAs side.

4-3. Estimation of Future Movement

The Agency of Industrial Science and Technology of MITI plans to develop a supercomputer for use in the developing devices in the cryogenic region. Based on this plan, a new project entitled "Research and Development of High Speed Computer System for Science and Technology", will start with the next budget year and will run for eight years. Estimated cost is ¥31 billion.

This project will research new devices, such as the Josephson junction, high mobility transistor, and GaAs field effect transistor (FET), and with this knowledge, try to achieve a computational speed fifty times higher than at present.

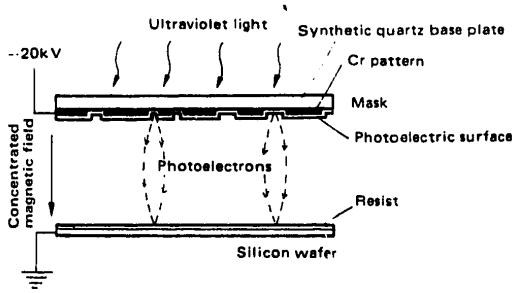


Fig. 8. Schematic Diagram of the Photoelectric Mask Transfer Method

5. Magnetic Bubble Memory

5-1. Present Status

Magnetic bubble memory is a large capacity file memory with good endurance, easy maintenance, high reliability, and nonvolatility.

At present, conventional (permalloy device) magnetic bubble memory is now under research and development by NTT, Fujitsu, Hitachi, and NEC to obtain 1M-byte device. Mass production of 64-256K-byte chips is already possible.

The 1M-byte device has a bubble diameter of 2 microns, bit period of 8 microns, chip size of 10 mm^2, and minimum pattern dimension of 1 micron. The fabrication technique uses a small number of maskings and consists of the ordinary photography technique (contact print or one tenth reducted exposure), dry etching technique, and newly developed planar technique.

However, the above conventional device is limited by the data rate (250 KHz) caused by the driving coil, the dimensional accuracy of pattern processing for permalloy transfer, and the memory density affected by the increasing rotating magnetic field that occurs as bubble diameter decreases.

Because of the demerits of the conventional type, research on a contiguous disk device has been started by Fujitsu. This device has a weaker driving field than the permalloy transfer type and a simpler transfer path, with larger pattern dimentions that are a minimum of two times the bubble diameter.

A new device expected to follow the contiguous disk type device is the dual conductor current access type which was announced by Bell Laboratories in 1979. (See Fig. 11) Because this device does not have a rotating magnetic field, its data rate will be around 1 MHz for 1M-byte device. Very little data are available on this device, but NEC and Oki have started basic research on it.

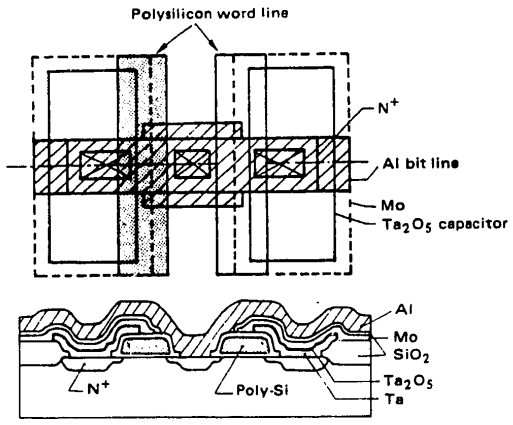


Fig. 9. (a) Structure of SHC RAM Cell

High density memory cell is fabricated by stacking Ta_2O_5 ferroelectric capacitors on QSA transistor

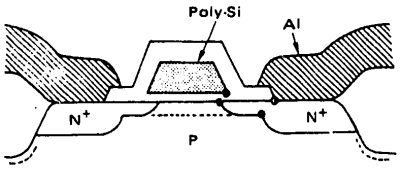


Fig. 9. (b) Structure of QSA (Quadruply Self Aligned) Transistor

Four points marked with " ⊙ " have self-matched structure and take up only a small area.

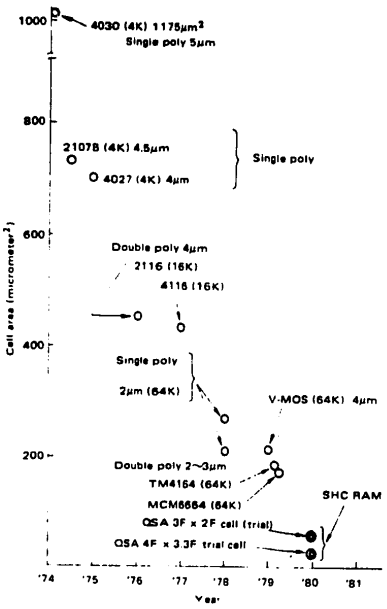
5-2. Review of Bubble Technology

Like semiconductor devices, bubble memory densities will increase 200% per year, and this growth rate will continue for the coming ten years. (See Fig. 12) As shown in the figure, 1Giga-byte devices will probably be possible by 1990, and even if this does not occur, 32M-byte to 256M-byte/10mm^2 devices will definitely be possible.

To develop larger memory capacity, the coilless type must be used, and the current driving system studied to obtain higher access speed.

5-3. Movement of the Application

On-line terminal files, system file for developing micro-computers, and disk substitution of small and medium capacities are now being marketed. In the future, the use will be extended to voice synthesis and CROM substitution fiels.



(the Density of Integration has Increased Rapidly Every Year by Introducing New Techniques)

6. Semiconductor Laser

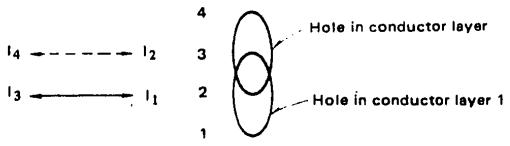
There are two reasons for developing semiconductor lasers. First, they use a short wavelength of 0.85 to 0.75 microns, and second. they can be used for long distance optical fiber communication systems in the 1.5 micron band.

To be used for short distances, the light emitting source of optical disk memory and optical printer, GaAs/GaAlAs or GaAs/InGaAsP type, must be developed in the wavelength band suitable for the development of sensitizers. Developments in this area are expected soon.

For long distance communications, the wavelength used must have a transmission loss of less than 1 dB/Km, and must use a multimode system that transmits many different wavelengths in a single fiber. This allows effective use of the high frequency characteristics at optical frequencies.

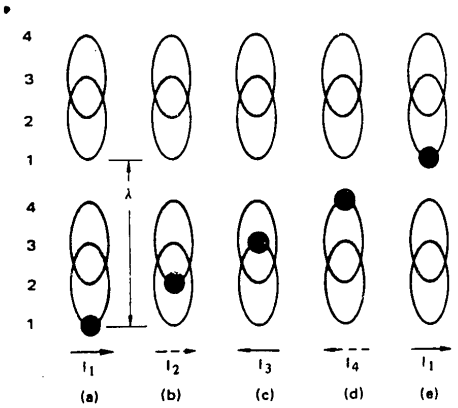
The CaInAsP system laser emits light with a wavelength of 0.92 to 1.67 microns, and a double heterostructure semiconductor laser with a cladding layer of InP has been developed in the 1.1 to 1.67 microns range.

Future problems to be resolved for semionductor lasers are the manufacturing technique of large crystals, lowering the cost by mass production, and increasing laser lifetime. Of these



(from Nikkei Electronics)

(a) Propagation pattern of bubbles in the two-layer conductors, and four positions along the propagation paths. When current is applied from I_1 to I_4, the bubble moves from position 1 to 4 by inhalation.



(b) Order of action of two-layer film shift resistor. When current is applied in the order of (e) to (a), the direction of bubble propagation is reversed.

Fig. 11. Mechanism of Bubble Propagation in Current-Driving-Type Magnetic Bubble Memories Using Two-Layer Conductors

problems, an epitaxial growth technique for mass production, MO-CVD (Metal Organic CVD), appears hopeful. In GaAlAs/GaAs system the growth reaction occurs in the temperature range of 550 to 880°C, and the rate of crystal growth is uniquely determined by the amount of the III group elements supplied to the base plate.

On the other hand, the MBE (Molecular Beam epitaxy) technique of crystal growth is particularly useful for compound semiconductors. This method uses a Knudsen cell as a vaporizing source of raw materials, that can easily control the amount

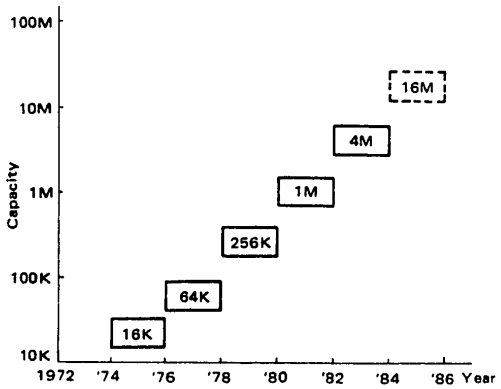


Fig. 12. Increase in Capacity of Bubble Memory

of vapor, and a slow rate (0.1 to 1.0 microns per hour) of crystal growth is possible in a high vacuum chamber.

Both methods are now under development, but the important roles of the semiconductor laser have recently been pointed out by the Council for Aeronautic and Electronic Technologies, an advisory board to the Science and Technology Agency. The report by the Committee, entitled "Promotion of Totalized Research and Development for Laser Engineering", states that it is important to promote the establishment of manufacturing techniques for large crystals for solid laser, development of mass production techniques for semiconductor laser by the MOCVD method, and the development of longer lived and more stable lasers for optical fiber communication.

7. Conclusion

In addition to the electronic devices already mentioned, many other devices, such as solar batteries, optical disk memories, and so forth, are now being researched and are going to be developed in the future. Japan will continue to make greater efforts to develop and commercialize new technologies for those devices. The competition between Japan and the U.S.A. in the semiconductor industry will increase drastically in light of the new industrial revolution initiated by VLSIs, Japan will continue to play an important role in the manufacturing and development of VLSIs, because she is the present favorite in the field.

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SCIENCE AND TECHNOLOGY

SENSOR FOR AUTOMATION

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 pp 26-29

[Article by Koichiro Shinohara, Omron Tateisi Electronics Co.]

[Text]

Sensors for automation seem a simple enough topic but they include a wide variety of types that have been developed such as those for checking temperature, mechanical quantities, humidity and gases. Commercial sensors available include hundreds of different kinds and are contributing to the developement of automation today.

This article concentrates on non-contact electronic inspection devices which represent the results of especially significant technoligical innovation among the numerous kinds of sensors available today and their applications are increasing.

1. Non-Contact Electronic Inspection Switches

Control systems for automation of production equipment have recently become of the electronic, complicated type incorporating computers, and of smaller-scale type often using standardized electronic sequencers. Consequently, as control systems are required to be higher-speed, to have longer-life, and to be of more intricate structure, sensors, which correspond to the eyes and tentacles of a control system, are becoming increasingly of the electronic non-contact type instead of the conventional mechanical type. Their purpose is for checking work for existence, position and dislocation. As typical sensors, one may mention proximity switches and photoelectric switches.

1-1. Proximity Switches

The proximity switch is designed to open or close electric circuits when it detects objects (primarily metallic) which approch to its detection face or which are present nearby, by making use of electromagnetic energy without needing mechanical contact. Such a switch has the following features:

1) The entire switch is contained in a rigid case. Thus, as it can be sealed completely, it is far more resistant to an unfavorable environment involving water, oil or dust than other types of switches.
2) Because it uses electromagnetic energy for detection, dust in the environment hardly affects it. On the other hand, because magnetic energy as emitted or received, such a switch's performance will vary with distance and it is effective within a distance of up to 100 mm at the most.
3) It is available in a variety of designs intended for different purposes, from a miniature type, like a microswitch, to a slab inspection type used in manufacturing steel plants.

1-2 Photoelectric Switches

The photoelectric switch is designed to open or close an electric circuit when it detects a variation in the quantity of light emitted from a light source directed at the switch, when the light is interrupted or reflected by passing objects. This switch has following features:
1 Because it makes use of beams of light for inspection, it is capable of inspection over some distance, some types having a range of up to 10 m. However, it is prone to cause erroneous operation if dust, etc. interrupt the beam, through causing variations in the light's intensity.
2 Those types which use light emitting diodes as light sources have a much longer life than those using conventional incandescent lamps.
3 Most types are rapidly being made very compact and are so designed as to be easily mounted on high-density systems with little mounting space, such as in automatic vending machines, copying machines and packing machines.

2. Recent Trends

2-1. Efforts to Apply and Certify Foreign Standards

The influence of the world's economy, with the rising value of the yen against the falling value of the dollar, is wide, inviting, in the market of inspection sensors, signs of internationalization in addition to increasing importation of inexpensive types of sensor, stimulating domestic makers to develop products to compete with imports. Efforts to apply and certify safety standards, such as UL and CSA or developments into models in compliance with such standards as DIN and CENELEC, promote increasing interchangeability and unification of functions and performance, are being welcomed as trends toward models common internationally and reliable in use.

2-2. Qualitative Improvement of Functions and Performance

Trends commonly observed today once technological development has been established, are increased competion to create new functions and higher performance, extension of such technology in contrast to a decreased number of new products based on new principles. Major examples observed in the field of inspection switches are as follows:

1 Addition of an Operation Indicator Light

Operation indicator lights which indicate the execution of detection are beginning to be fitted on nearly all varieties. Photoelectric switches additionally are being provided with the function of "stable- operation range indication" which illuminates the indicator light when a detection signal at a level with aclequate allowance. This has reduced trouble due to improper setting for optical axis alignemnt, etc. and has made inspection switches more easy to use.

2 Short-Circuit Protection Function

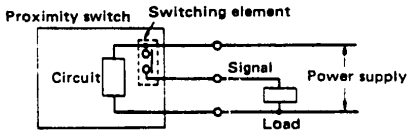
Inspection switches using semiconductors, which quite often become damaged, are being provided with functions for detecting short-circuit currents and so protect load switching elements before they cause other losses.

3 Simplification of Wiring

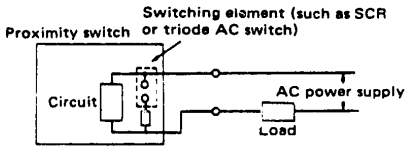
For proximity switches, the two-wire type is increasing besides the conventional 3-wire type (two wires for power supply and one wire for signals). Two-wire proximity switches are provided with SCR and triode AC switches in their inner circuits to switch line currents directly. These can be used just like microswitches and limit switches, enabling the number of manhours for wiring work and materials for wiring to be reduced and thus, to prove more economical when used in quantity (see Fig. 1).

2-3. Trends Toward Compactness

Since it is the duty of inspection switches to perform functions equivalent to the eyes and tentaches of control systems, it is very important have them as small us possible. This makes them easior to mount and to perform such processes as amplification of signals from inspection circuits, trimming of waveforms in the switches, in order to provide definite digital output in the form of "1" and "0". In order words, the incorporation of amplifier functions, which will ensure signal transmission and will eliminate the use of special cables such as shield wires for leads. Figs. 2 and 3 show earlies and the latest proximity switches and photoelectric switches for comparison of size. The greatest factors which have made such compactness possible are the techniques for modifying circuits into IC types and HIC technology which has achieved high integration of various semiconductor caps.

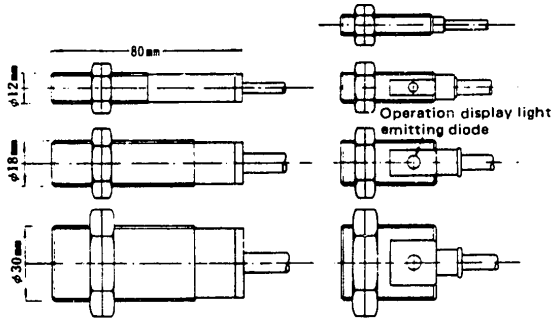


(a) 3-Wire proximity switch



(b) 2-Wire proximity switch

Fig. 1. Wiring of Proximity Switches



(a) Conventional (b) Latest (DC type)

Fig. 2. Comparison in Size between Conventional and Latest Proximity Switches

3. Typical Applications

3-1. Checking on Presence of Steel Plates

Fig. 4 shows an application of a proximity switch in checking to see whether punched steel plates are on the line or not. The use of a cylindrical shield type switch will permit correct inspection nearly free from the effects of operational distance, even if it is buried in the same mold, as in this example, and will enable the press, which is about to run out of materials, to be stopped.

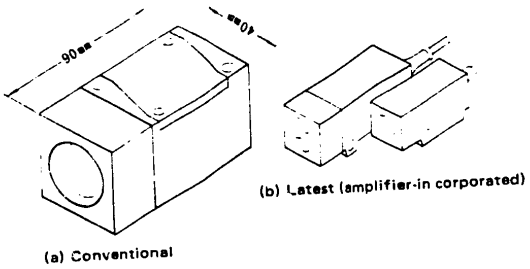


Fig. 3. Comparison in Size between Conventional and Latest Photoelectric Switches

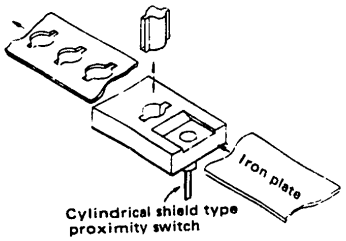


Fig. 4. Checking for Existence of Iron Plates by Proximity Switch

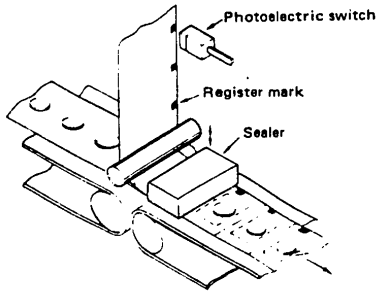


Fig. 5. Detection of Register Mark by Photoelectric Switch

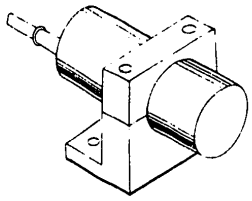


Fig. 6. Electrostatic-Capacity Proximity Switch

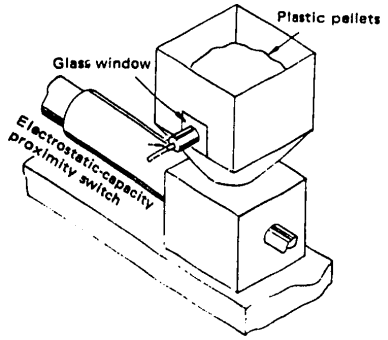


Fig. 7. Electrostatic-Capacity Proximity Switch Used for Controlling Level of Plastic Pellets in Hopper

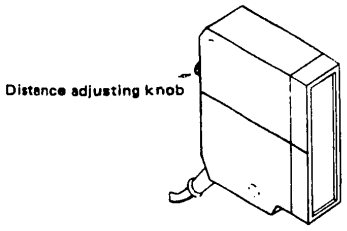


Fig. 8. Limited Reflective Photoelectric Switch

3-2 Detection of Packing Register Mark

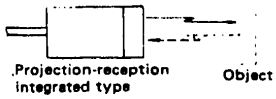
Fig. 5 shows an application of a reflective photoelectric switch which ensures objects are in the proper position on an automatic packing line. On the packing paper, register marks are printed to be read by a photoelectric switch. This system is applicable to various types of packing materials including thick opaque boards and transparent paper.

4. Latest New Commercial Products

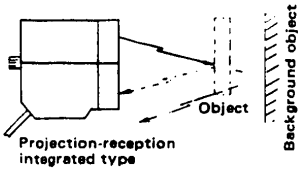
Out of those inspection switches recently appearing on the market, two models using new principles or designs and which are developing applications previously left unexploited are described below.

4-1. Electrostatic-Capacity Proximity Switch (See Fig. 6)

Objects which proximity switches currently available inspect have been limited to metals, as it has been difficult for such proximity switches to inspect non-metallic objects and liquids. The electrostatic- capacity proximity switch is designed to give output by detecting the electrostatic capacity of the object as it approaches the detection face. It responds to glass, plastics, ceramics, wood, etc., though it more readily responds to substances with large relative permitivity such as metals and water. The switch is quite able to check the presence of liquid in paper packs and is most adept in checking liquid levels in milk packs. Fig. 7 shows an application in which an electrostatic-capacity proximity switch is set on the window on the side of the hopper of an injection molding machine to automatically control the level of plastic pellets in the hopper.



(a) Beam from diffusive reflective photoelectric switch



(b) Beam for limited reflective photoelectric switch

Fig. 9. Difference in Beam between Diffusive Reflective Photoelectric Switch and Limited Reflective Photoelectric Switch

4-2. Limited Reflective Photoelectric Switch (See Fig. 8)

In diffusion-reflective photoelectric switches currently used, the projection axis and the reception axis are fixed in parallel. Thus, they have had the drawback of having difficulty in discriminating between the object under inspection and foreign objects in the background (such as wells and conveyor surfaces), though it is handily able to receive diffused reflections from the front face of the object under inspection. The limited reflective photoelectric switch has the reception axis at an angle with the projection axis and incorporates an adjusting system which is able to vary the intersection of the two axis. Thus, the switch is able to receive selectively only the reflections from the objects under inspection. Fig. 9 shows its principles. The switch is applicable for continuously counting passing solid objects, that is, chocolate bars, tiles, pipes and pencils that are fed successively on to a line or for the stable inspection of transparent objects.

CSO: 4120

SCIENCE AND TECHNOLOGY

USE OF OPTICAL SENSORS DESCRIBED

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 pp 30-33

[Article by Suguru Kumagaya, Shinko Giken Co., Hisashi Tamura, Shinko Giken Co., and Hiroshi Mizuno, Shinko Giken Co.]

[Text]

1. Using Permeable Photoelectric Units

Needing no physical contact, in automation, photoelectric inspection is often more convenient than other methods to control work operations.

Photoelectric check systems, however, will not work satisfactorily if the light necessary is not arranged carefully. For small workpieces, as shown in Fig. 1, the use of a usual commercial photoelectric check unit will involve erroneous operation because the sensitivity required calls for adjustment that is two fine to be practical. Here, the detection sensitivity is low because the light beam is relatively large as compared with the workpiece which obstructs only a small portion of the total light reaching the reception element. And, since the same amount of light reaches the photoelectric element irrespective of the position of the workpiece in the light beam, it is not possible to use this system for work positioning.

The above problem with small workpieces can then be solved by adequate restricting of the light beam as shown in Fig. 2. Photo 1 shows an example of this system, which detects the location of a workpiece about 3mm in diameter, with an error of about 0.5 mm. The photoelectric detection unit in the Photo is positioned as shown in Fig. 3.

On the other hand, there are cases in which the light beam has to be enlarged. In a process feeding E shape core parts one by one as shown in Fig. 4, suppose two of them were entangled as shown in Fig.6, one of the methods of detecting such is by enlarging the full light beam as shown in Fig. 6. Here, appropriate selection of the shape and the dimensions of the projection frame will enable workpieces consisting of two a more entangled parts and facing in any direction to be detected.

Next, let us consider a detection unit, which gives a signal the moment any obstacle enters a certain plane and which can be used as a safety unit for presses.

It is usual to think that this can be done by enlarging the light beam as shown in Fig. 7. However, if the thickness D of the object under detection is too small for the beam width W as with small work shown in Fig.1, sensitivity will decrease. If the sensitivity is sufficiently raised to detect such small thicknesses, this will cause erroneous operations because small variations are ready to generate signals.

On the other hand, small objects can be detected efficiently by applying the method of covering the entire monitor surface, by allowing a long-distance photoelectric unit to reflect the light beam onto mirrors, as shown in Fig. 8. Here, the light beam from the light source runs with a nearly constant width after it passes through condenser L_1 and, successively being reflected by mirrors M_1, M_2 ..... M_{11} to reach the reception element after being condensed by condenser L_2. Since the size of the beam can be considered to be equal to the diameter of condenser L_2, variation in the quantity of light is expressed by D/WL in contrast to D/W in Fig. 7, where D denotes the diameter of the object under inspection. This indicates a relatively high sensitivity and suggests the advantage of covering a considerably large area.

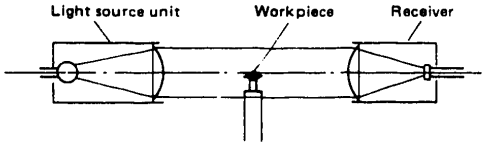


Fig. 1. Ordinary Pass-Through Photoelectric Unit Is Difficult to Use for Inspection of Small Workpieces

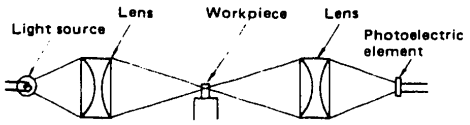


Fig. 2. Photoelectric Inspection of Small Workpieces

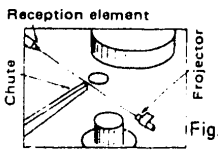


Fig. 3. Setting of Photoelectric Inspection Unit in Photo 1

Fig. 4. Feeding of E-Type Cores

Fig. 5. E-Type Cores Entangled

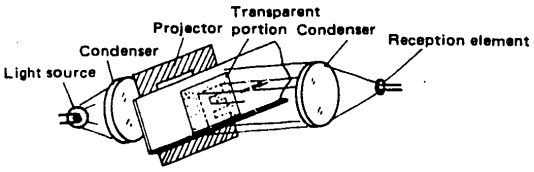


Fig. 6. Inspection for E-type Cores Entangled

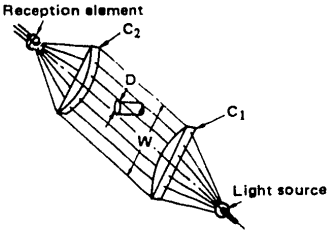


Fig. 7. Light Beam Enlarged

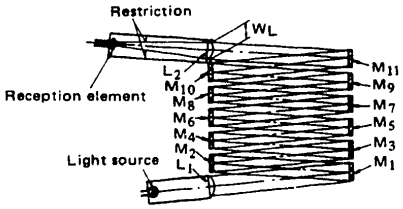


Fig. 8. Long-Distance Photoelectric Unit

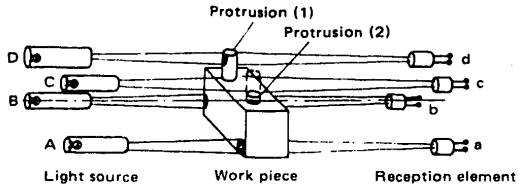


Fig. 9. Multipoint Checking Using Photoelectric Inspection Unit

2. Picture Detection Photoelectric Unit (I)

It is often desired to inspect the overall conditions of products instead of their presence. In such cases, the use of a group of photoelectric elements and a group of light sources arranged appropriately around the work, as shown in Fig.9, seemingly will serve the purpose. The example given in Fig. 9 shows that if C-c is on and D-d is off when A-a and B-b are off, the work is positioned properly and vice versa.

In practice, however, this presents a number of difficulties, such as it is not always easy to arrange these beams in this way primarily, because of spatial limitations, it is difficult with small work to set a light reflection unit as shown in the Figure and it is necessary to devise a fixture every time a new type of product is put on the line. In order to solve these difficulties, a simplified picture detection unit has been developed. It is a simplified pattern check unit shown in Photo 2.

It is somewhat slightly larger than an 8mm camera and is accompanied by a control box about a step smaller. It is used as follows. First, it is set as shown in Fig. 10. With the back lid opened, the picture of the work is seen on the 50mm x 50mm print glass. What remains to be done here, is to set and clamp 4 photoelectric elements of 4 locations in the picture and adjust the output levels of the individual photoelectric elements to the ON or OFF position by turning the level adjusting knobs.

Let us take, for example, the picture of the workpiece as shown in Fig. 11(a). If the workpiece shows clearly againt a dark background, suppose that the 4 photoelectric elements are set as shown in Fig. 11(b). In this setting, the beams to elements A, B, C and D are dark, bright, bright and bright with outputs. OFF, ON, ON and ON respectively, which is expressed as 0111 under the binary system, and the decoder output of the control box appears as a signal at location No. 14. Then, suppose this is the output of "normal" work conditions. If the top protrusion of the subsequent work which comes to position as the index table turns is inclined as shown in Fig. 11(c), the code of the photoelectric signal is 0101 and the signal for state output appears at No. 10. This results in no output at No. 14 and, thus, the work is judged to be "abnormal". Likewise, if the work is wrongly positioned leftward or rightward as shown in (d) and (e) of Fig. 11, signal codes are 1100 and 0001 respectively and signals appear at state output Nos. 3 and 8, with no signal appearing at No. 14. Thus, both cases are judged to be "abnormal". However, by monitoring Nos. 10, 3 and 8, it can be made clear how they are abnormal.

Where there are several kinds of work on the line such as on painting lines, the unit can be used for discriminating between different kinds of work. Suppose the unit is installed in a painting line, as shown in Fig.12, and the photoelectric elements are set in the print glass, as shown in Fig. 13. Because element C is always off when the work is in position, state output takes only 8 forms:

0000; 1000; 0100; 1100; 0001; 1001; 0101; 1101 or No. 0; No. 1; No. 2; No. 3; No. 8; No. 9; No. 10; No. 11

Listing of the kinds of workpiece given in Fig. 13 will show state output as follows:

0000–No.0	workpiece (1)
0001–No.8	workpiece (2)
1000–No.1	workpiece (3)
0100–No.2	workpiece (4)
1101–No.11	no workpiece

This suggests that it is very easy to discriminate between kinds of workpieces.

The unit has the following features; it takes only a few minutes to set the system because the photoelectric elements can be set while observing the point glass. For the smallest workpiece, the photoelectric elements can be set at the desired locations in the picture because the picture can be enlarged up to about 10 times. Also, in terms of price, the unit is handy as a check unit for ordinary automatic assemblers. It also has the merit of easily being used with other assemblers if the original automatic assembler is scrapped because of a change of products.

3. Picture Detection Photoelectric Unit (II)

Another type of picture detection photoelectric unit is shown in Photo 3. It is similar to the unit described earlier in that it detects deviations from the "normal" state of the workpiece. At the same time, it can be considered as an advanced type which does not require rearrangement of photoelectric elements. Like a television set, this unit consistently scans the screen. Thus, after setting as in Fig.9, the "normal state" can be recorded in 2 sec. by placing "normal" work and simply pressing the "record" pushbutton switch.

Only giving a "detection operation command" is required in order to allow the unit to check the workpiece against a "normal" workpiece and if it is different, to give a signal. The unit operates as follows: it scans, by using a rotating drum with pinholes, the picture of the work produced by the objective lens as shown Fig. 14,0 detects and amplifies variations in its quantity of light by using photoelectric elements and records them as analog signals on a magnetic tape would on the rotating drum. Two channels are provided for recording and they can be reproduced simultaneously.

The rotating drum has 24 pinholes so that the entire screen is scanned by 24 lines during a single rotation of the drum. The unit is operated as follows:

(1) With a normal workpiece set in position, the picture is checked on the single-lens-reflex type print glass to bring the work into the focus.

(2) The "Record" push button switch is pressed (or an external signal is given) to record a normal state on channel A.

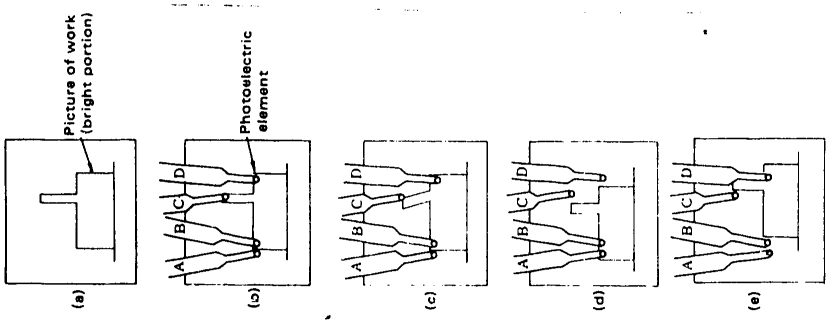


Fig. 11. Methods of Pattern Checking

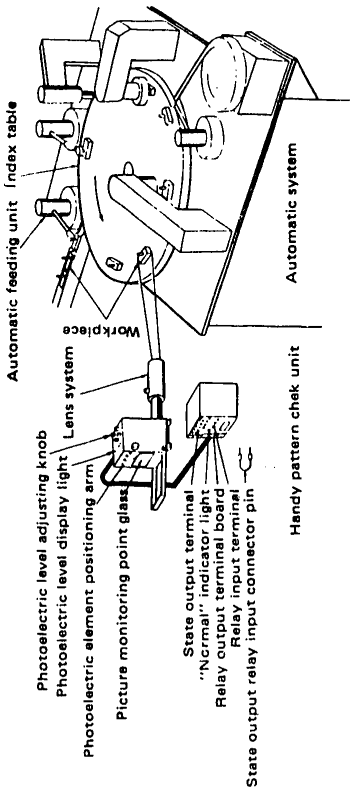


Fig. 10. An Application of Picture Inspection Photoelectric Unit

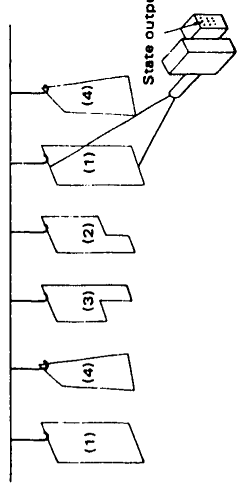


Fig. 12. Check Unit for Discriminating between Work Kinds on a Mixed Work Line

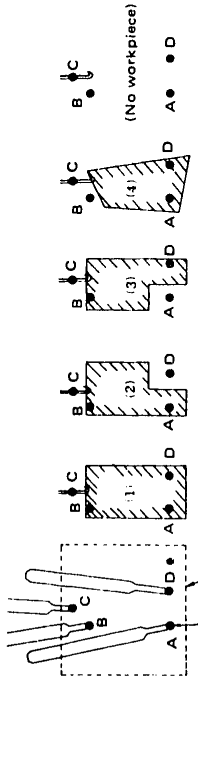


Fig. 13. An Arrangement of Photoelectric Element of Check Unit

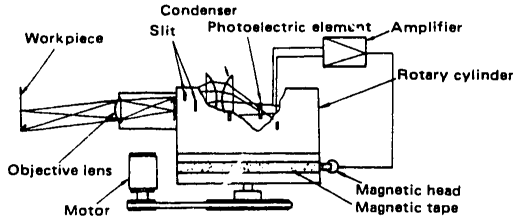


Fig. 14. Optical-Sweep Pattern Comparison Inspection Unit (Made by Shinko Technology Laboratory)

Table 1. Specifications of Optical-Sweep Pattern Comparison Unit

Item	Specifications
Objective lens	80mm F1:1.9
Screen size	19mm x 24mm
Number of scanning lines	24
Width of scanning slit	0.8mm
Scanning speed	Full screen/sec
Resolving power	±0.3mm
Finder	Single lens reflex type
Number of recording channesl	2
Gate signal	Scanning start position signal and external gate signal
Illumination	DC illumination
Dimensions of main unit	370L x 170W x 180H
Weight of main unit	8.5kg
Power supply	100V 50–60Hz

(3) Allowing channel B to operate by pressing the "Inspect" pushbutton switch (or giving an external signal) causes channel A to reproduce its records, while causing channel B to record and reproduce the picture of the current workpiece repeatedly so that the unit compares reproduced waveforms between both channels.

(4) Highest sensitivity is obtained by adjusting the sensitivity to the highest possible level just before a fault signal is received. Where some tolerance is required as to location, sensitivity can be adjusted to a level just before a fault signal is received with the workpiece moved to the limit of location. Also, adjustments can be made against limited samples such as "work deformations."

(5) After this cycle, the unit successively inspects workpieces automatically and gives appropriate signals.

The main specifications of the unit are shown in Table 2. The advantage of this unit over the 4-element type described ealier is that it is able to detect abnormalities at any locations in the picture and thus, it is suited to applications where workpieces involve unexpected variations. Also, it is very helpful in multi-line small-lot production because it is able to change product kind in 2 seconds by simply using external signals. Although it is slightly more expensive than the 4-element type, it can be used as a handy instrument for pattern recognition at rather low cost.

CSO: 4120

SCIENCE AND TECHNOLOGY

OPERATING PRINCIPLES, APPLICATIONS OF AIR SENSORS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 pp 34-38

[Article by Tasuku Osada, Yamanashi University]

[Text]

Recently, much progress has been made in measuring and detecting techniques using industrial robots and various types of labor saving instruments. The control system used for this depends on the features of the overall system and uses either air pressure, oil pressure, electronic, or mechanical sensors.

Air pressure systems have the advantages of being easy to operate, having few adverse environmental characteristics, and being able to operate for long periods of time without generating a lot of heat. These characteristics contribute to the promotion of air pressure systems in the field of measuring and detecting techniques to enhance automation and save labor. General air sensors can be divided into the following: back pressure type, eddy type, reflecting type, collision type, deflecting type, laminar flow- turbulent flow type, velocity-of-flow type, supersonic type, and composite type. They are selected depending on the characteristics of the object to be controlled.

1. Back pressure sensors

Air micrometers and nozzle flappers are detectors that use air pressure. A micrometer is a device by which a change in back pressure or a change in flow rate is measured by ports in a manometer. A back pressure sensor is a detector based on this principle (refer to Fig. 1), in which air pressure is supplied from port Ps and an air jet is emitted from nozzle D. The change in back pressure produced at this time is taken out by port Po. The simple construction of this sensor makes it dust-free and compact. Fig. 2 shows the relationship between sensitive space H and output Po. Back pressure sensors have a large $\tan\theta$ as shown and make excellent dimension discriminating sensors. Further, the construction of the detecting end nozzle is simple,

as shown in Fig. 3. This makes the back pressure sensor smaller. The back pressure producing section is to the rear to give a wide scope of application.

Features

(1) The relation between nozzle diameter D and sensitive space H is such that the maximum sensitive space is about 1/4 the nozzle diameter. For example, when the nozzle diameter is 2mm, Hmax is 0.5mm.

(2) The most economical quantity of flow consumed is when nozzle diameter D is about 2mm.

(3) When the sensor output is connected to a fluidics circuit, pressure Ps supplied to the sensor will be 0.5 kg/cm^{2}G. High pressure of 1.5 to 3.0 kg/cm^{2}G as is required for conventional air pressure circuits is not necessary.

(4) The response speed is about 400 Hz.

(5) Resolution is about 1/100mm to 1/1000mm. There are many cases where the back pressure sensor having precise resolution is used as a sensor for air micrometers.

2. Eddy type sensor

See Fig. 4. When air pressure is supplied from port Ps, an eddy chamber causes the air flow to swirl and be emitted from detecting port S. This causes a negative pressure at output port Po. Fig. 5 shows the relationship between sensitive space H of the sensor and output Po of the sensor.

As shown, as sensitive space H becomes smaller and as a detecting object approaches the sensor, the greater the negative pressure generated. Sensitive space Hmax is about 12mm.

Features

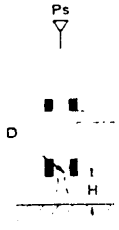


Fig. 1.

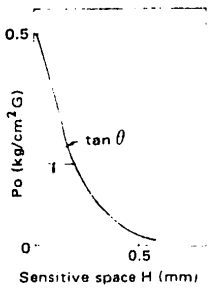


Fig. 2.

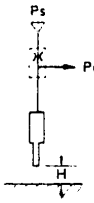


Fig. 3.

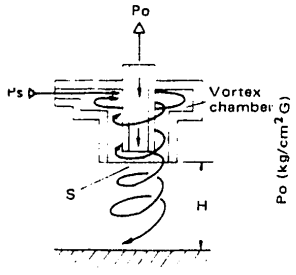


Fig. 4.

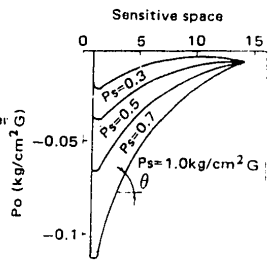


Fig. 5.

(1) Output Po is a negative pressure so that atmospheric gas cannot enter the sensor, and thus is very suitable for use in adverse atmospheric conditions.
(2) As shown in Fig. 5, tanθ is small as compared with the back pressure and reflecting sensors.
(3) Resolution is about 1/10mm and is particularly suited for ON-OFF control.
(4) Response speed is not greater than about 30 Hz – making the eddy current sensor the slowest air sensor. However, eddy current sensors have good stability.

3. Reflecting type sensor

See Fig. 6. When air pressure is supplied from port Ps, an air jet is output from detecting nozzle S, and the flow reflected from the surface of the detecting object is output from output port Po of the sensor. Fig. 7 shows the relationship between sensitive space H and Po/Ps where Po=output pressure and Ps=supplied pressure. As shown,the output characteristics of the reflecting type sensor are similar to those of the back pressure type sensor. Placing Ho shown in Fig. 7 at the center of the sensitive space, gives the output better linearity in relation to the displacement of the detecting object.

Features
(1) Large tanθ as shown in Fig. 7 and better linearity enable set sensitive space H to be relatively large.
(2) The minimum area required for the detecting object must be greater than diameter D of the detecting nozzle that reflects the air jet.

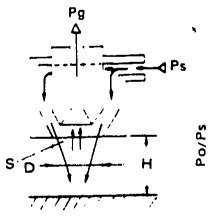


Fig. 6.

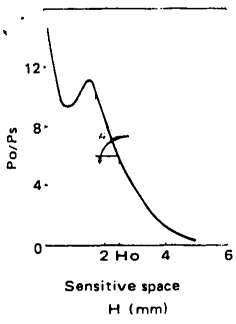


Fig. 7.

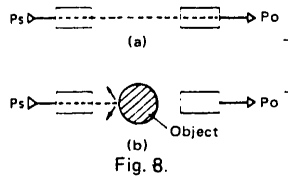


Fig. 8.

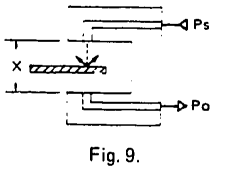


Fig. 9.

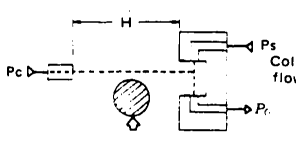


Fig. 10.

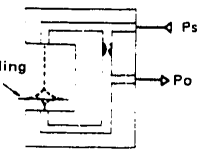


Fig. 11.

(3) It is best suited to flat objects since irregular objects will deflect the airflow and not give a true reflection.
(4) Resolution is about 1/10mm to 5/100mm.
(5) Response speed is about 400 Hz.

4. Confronting type sensor

Fig. 8(a) shows the operating principle of the confronting type sensor. When no object is between supply nozzle Ps and flow receiving nozzle Po, the air jet from supply nozzle Ps becomes the output of flow receiving nozzle Po. Fig. 8(b) shows the case where on object is between Ps and Po. An air jet from supply nozzle Ps is blocked by the object and cannot be received at flow receiving nozzle Po. In actual use, air pressure supply port Ps and output port Po are on the same axis and are arranged in a] shape as shown in Fig. 9. If the object is larger than the distance indicated by X in the Figure, a turbulent flow type shown in Fig. 10 is used. As is shown in the Figure, when there is no object, the air flow from control nozzle Pc impinges on the air jet from supply nozzle Ps so as to cause a turbulent flow. As a result, the output at port Po becomes very small. When the object shown intercepts the air jet from Ps, Ps is output at port Po as is. Hmax obtained by this system is about 400mm.

Features
(1) It is used in laminar-flow regions where the supply pressure of the air jet is 0.5 kg/cm^{2}G or less, and it is best suited for detecting thin objects.
(2) Confronting distance X is normally 10mm to 30mm.
(3) The output signal is a NOT (negative) signal.
(4) Response speed is about 300 Hz.
(5) For the turbulent flow type shown in Fig.10, high pressure of about 2.0 kg/cm^{2}G or more is required at Ps and Pc when H is 400mm.
(6) Response speed of the turbulent flow type is about 50 Hz.

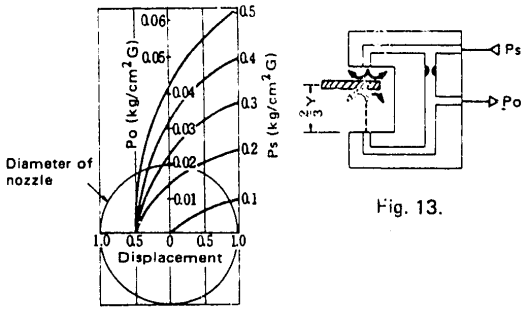


Fig. 12.

Fig. 13.

5. Collision type sensor

A collision type sensor is based on the confronting type sensor, the difference being that the air jet is emitted from flow receiving port Po, and that the air jet from Po collides with the air jet from supply port Ps. Ps is adjusted to a higher pressure than Po. This generates a radial-jet type impact flow in the vicinity of flow receiving port Po, so that a back pressure is obtained at port Po. If an object is between the ports, there is no colliding point and no back pressure output is obtained. Fig. 12 shows the relationship between the displacement of a film-like object and nozzle diameter.

Features

(1) Detection even in polluted environments does not cause port blockage because air is exhausted from supply port Ps and flow receiving port Po.

(2) The detecting object should be placed near the supply port. The recommended position is 2/3Y (refer to Fig. 13).

(3) Has the best pressure sentivity.

(4) Resolution is about 1/100mm at the edge displacement of an object.

(5) Response speed is 400 Hz.

6. Applications

6-1. Discrimination between dimensions of objects

Fig. 14 shows how object dimensions are discriminated between while an object is conveyed. A back pressure type sensor is used, but an eddy type or reflecting type could be used depending on the shape of the objects. As shown, one or two air sensors are needed. In a simple system using only one sensor, a signal is created only when the object exceeds the normal dimensions. If discrimination between the upper and lower limit dimensions of an object is desired, two Schmidt fluidics

elements are used and the output of one air sensor is used as the input of each Schmidt elemer . so that output is obtained when it exceeds the upper or lower limit of the dimension determined by the Schmidt element and trigger levels. This method enables dimensions to be discriminated between by varying the selected height of two air sensors.

6-2. Detection when objects contact each other

Fig. 15 shows detection when objects are in contact with each other. Back pressure type, eddy type, and reflecting type sensors are used. When using reflecting and confronting types using photoelectric elements, the reflecting type will give erroneous readings depending on the shape and color of the objects; diffused reflection is caused by diffused light and dusty environments. The confronting type cannot be used when objects are in contact with each other. In both cases, the problem can be solved by using air sensors of the maximum height of the objects as shown.

6-3. Detection of parts standing in a row

Fig. 16 shows the detection of parts standing in a row for automatic assembly or welding. Prevention of poor assembly in assembling processes or of electrodes being broken in welding requires correct orientation of parts. Eddy type sensors can detect the difference between a flat surface and a curved surface as shown. Eddy type sensors can also detect objects even if they have holes in their surfaces (for bolts, etc).

6-4. Recognition of objects being passed

Fig. 17 shows how objects made of different materials are recognized when air-conveyed to the secondary process (when back pressure type, reflecting type, and eddy type sensors are used). During conveyance by air pressure, the air pressure influences the sensor. The back pressure type and reflecting type are effective in this situation as shown in Fig. 17. Each of

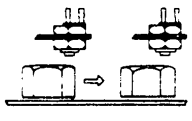


Fig. 14.

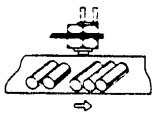


Fig. 15.

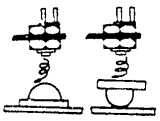


Fig. 16.

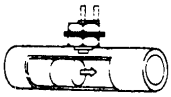


Fig. 17.

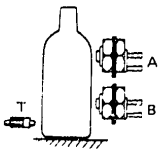


Fig. 18.

the sensors outputs a signal for positive pressure. This means that air pressure for conveyance must be limited to 2kg/cm^2 G or less. Considering this, eddy type sensors should be used to give a signal for negative pressure. The eddy type sensor outputs a signal oriented more to the negative pressure created when each object passes and is not affected by the air pressure used for conveyance.

6-5. Detection using two sensors

Fig. 18 shows detection using two sensors (back pressure type, eddy type, and reflecting type).

(a) Detection of inverted objects in automatic assembly

Inversion is judged from the signal obtained by the timing of sensor T with the outputs of sensor A and sensor B connected to an AND element.

(b) Detection ofy inclination of works

The limit for the angle of inclination is output from a signal obtained by the timing of sensor T with the outputs of sensor A and sensor B connected to a comparator which is set to the inclination limit.

(c) Detecting dirty sensors

The difference between the outputs of sensor A and sensor B is output when there is no output from a timing sensor (in the absence of an object). If any difference is detected, cleaning is required. A warning is issued, and detection is suspended. However, the basic requirement for this system is that both sensors observing the same process do not become equally dirty.

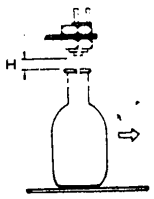


Fig. 19.

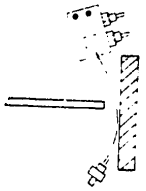


Fig. 20.

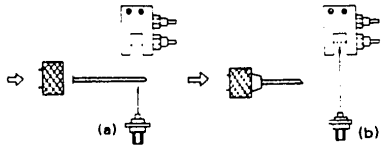


Fig. 21.

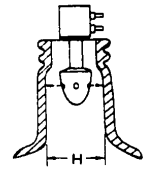
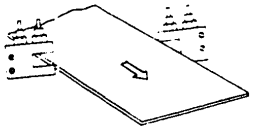


Fig. 22.



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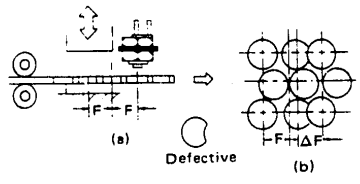

Fig. 24.

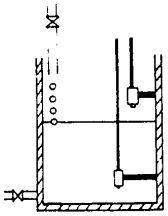

Fig. 25.

6-6. Detection of inferior molded articles

Fig. 19 shows the detection of top flows and waves of bottles (back pressure type, eddy type, and reflecting type sensors are used). Detection of inferior molded articles by photo-electric type and electromagnetic type sensors is limited by the material used for the molded articles. However, detection by air sensors does not have this drawback. A sensor is adjusted so that the space between the sensor and the object becomes H as shown, and so that the circumference of the tip of a bottle can be detected at the same time.

6-7. Recognition of striking the object

Fig. 20 shows the recognition of a position to be determined by a striking board (a turbulent-flow type sensor is used). This detects inferior products that are too short, and so forth. In this system, when the thickness of an object is more than 3 mm, air pressure from Pc creates the wall adhesion phenomenon at the side of the object, so that the output signal from a detector becomes unstable. Accordingly, film-like objects are suited for this system.

6-8. Detection a broken drill

Fig. 21 shows the detection of a broken drill during a process. Fig. 21(a) shows the state where there is no breakage, while Fig. 21(b) shows the state where a drill is broken. The sensor used is the turbulent-flow type. Detection of a broken drill is judged by the existence of the tip of the drill. When detecting a broken drill during a process, the process conditions complicate the location of the sensor. Accordingly, the sensor is located so that it can detect when the drill arm is returned to its original position after drilling. Locating a sensor closer to the drill permits observation of chipping of the edge of the drill.

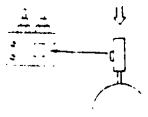

Fig. 26.

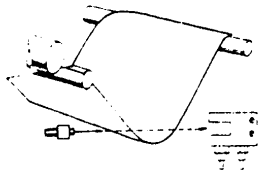

Fig. 27.

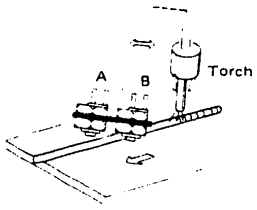

Fig. 28.

6-9. Detecting the inner diameter of a throat

Fig. 22 shows the detection of the inner diameter of the throat of a bottle (back pressure type, edge type and reflecting type sensors are used). The inner diameter of the throat of a bottle is larger than the top of the throat. This prevents overflow in automatic bottling. Thus, on air sensor detects what is larger than the entrance of an object. A striking board is used to determine the position of the sensor so that the detecting position is always set at a predetermined distance from the throat tip.

6-10. Detecting width

Fig. 23 shows the detection of the width of rolled plates, for example a collision type sensor is used. When the width of a rolled plate reaches the upper and lower limits, a warning is issued, or it is corrected by a correcting mechanism that operates a cutting machine. With the collision type sensor, outputs having the characteristics shown in Fig. 12 can be obtained for a plate thickness of 3 mm or less. They become unstable, however, for a plate thickness of about 4 mm because the flow from supply port Ps is affected by the Koanda effect causing repeated ON and OFF signals. Thick plates are discriminated by gate elements using several confronting type sensors.

6-11. Detecting punch failure

Fig. 24 shows the detection of defective products in punching operations (back pressure type, reflecting type, eddy type, and confronting type sensors are used). Defective products in press-punching operations must be visually inspected by an operator or must be inspected by a measuring instrument. Defective products are mostly caused by the feed of hoop materials. Generally, grip feeders and pinch rollers are used and defects are caused when regulated dimension feed is prevented by shippage or backward movement. Whether punched pieces are fed in regulated dimension F is detected synchronously with the upper half of a press. When feed is $-\Delta F$ as shown in Fig. 24(b), the upper half of the press is stopped.

6-12. Detecting a liquid surface

Fig. 25 shows the detection of the upper and lower limits of a liquid surface (back pressure type, eddy type, and reflecting type sensors are used.) Detection of a liquid surface requires selecting the detecting conditions and air sensors to match the liquid. For example, when an air bubble is contained in a liquid

(air purge type), when an air bubble is not contained in a liquid, when liquid adheres to air sensors, etc. For example, in the detection of a low-viscosity liquid, positive pressure from a sensor generates wave patterns on the surfaces and markedly lowers detecting precision. This requires that a negative pressure sensor be used to increase detection precision.

6-13. Detecting nozzle failure

Fig. 26 shows the detection of a clogged nozzle (confronting type and collision type sensors are used.) This method is used to detect clogged spray gun nozzles, where it would be dangerous for operators because of poisonous chemicals. Products dealing with gases must be explosion-proof. As shown in Fig. 26, presence of mist is detected by an air sensor with a timer that causes an air cylinder to push a nozzle. This system can use full air pressure.

6-14. Detecting a web loop

Fig. 27 shows the detection of a web loop in materials. The figure shows a turbulent-flow type air sensor, detecting loop positions to keep the quantity of materials stored in a feed loop of a web constant and to activate a driving well for increases or decreases in the size of the loop. One air sensor is enough if the limit of the loop is described as a single value, while two sensors are needed if both an upper and lower limit must be set.

6-15. Automatic torch chasing

Fig. 28 shows automatic torch chasing in welding (back pressure type, eddy type, and reflecting type sensors are used.) In welding, air pressure detectors are superior to photo-electric types or electro-magnetic types. In the figure, the torch is automatically kept within the specified range in which sensors A and B are located. Accordingly, automatic chasing is possible even if a welded section forms a zigzag pattern. To raise the response speed, a Schmidt element turns sensor outputs into ON-OFF signals that control the system. Use of air pressure devices to correct the torch position enables full air pressure control.

CSO: 4120

SCIENCE AND TECHNOLOGY

INTRODUCTION TO MECHANICAL FINGERS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 pp 39-42

[Article by Tatsuo Takahisa, Canon, Inc.]

[Text]

1. Introduction

Separate thought must be given to fingers used by industrial robots and to fingers used in artificial hands for human beings. It is not surprising that artificial hands receive much attention in feature articles about industrial robots and that pick & place units (p & p units) and their fingers are described mostly in terms of artificial hands. It is barely tolerable that fingers for both should be compared in feature articles on versatile "robots" for industry. They should be treated quite separately. Both should discussed without discrimination when those developed for medical use can also be used industrially and vice versa (refer to photographs 1 and 2).

This caused us to consider that possibly those for industrial use should not be called fingere. So, similar terms are described here and unexpectedly many exist.

(1) Hand
(2) Finger
(3) Grip
(4) Clamp
(5) Chuck
(6) Nail

Of the above, 3 , 4 and 5 are not names applied to parts of the human body and thus may be used industrially, while 1 , 2 and 6 being names used for the human body, are better used for artificial hands. However, expressions using words related to human beings are easily understood by everbody, and it may cause no difference which words are used.

However, this article features fingers and once again let us examine whether the word "finger" is most suitable or not, by comparing expressions concerning motion, face to face with those related to the body.

Pick	→	Grasp	→	Clasp	→	Hold	→	Carry
Nail	→	Finger	→	Hand	→	Arm	→	Body

The above comparison shows that this feature concerns "Grasp". However, small things must be picked up with nails or tweezers, and large things must be clasped. Accordingly, this feature article on "fingers" includes examples from "pick" for watches to "clasp" for automobiles, which are written by contributors in respective fields.

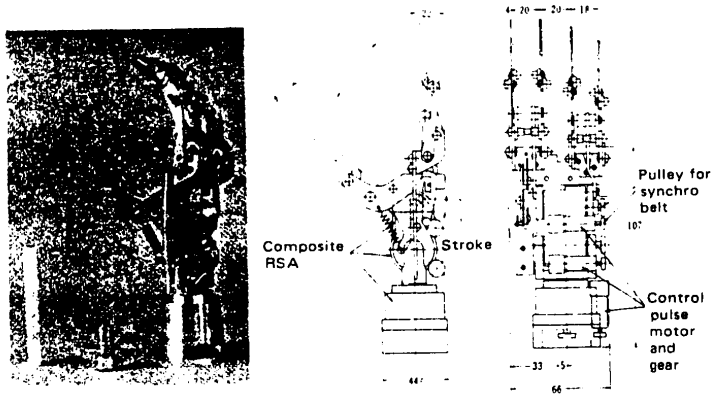

Photo 1. Example of an Artificial Hand (Waseda University)

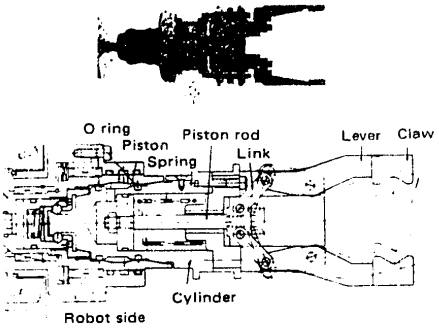

Photo 2. Example of a Mechanical Hand (Kawasaki Heavy Industrial Co.)

2. Needs for Fingers

There are various needs for fingers. They are divided into four kinds.

(1) Requirement for fingers from the aspect of work handled

(a) Size (volume) of work
(b) Weight of work
(c) Flaw threshold of work
(d) Deformation threshold of work
(e) Clamped section and precision of work

(2) Requirements for fingers from the aspect of equipment

(a) Fixing direction and shape equipment
(b) Measures against vibration and moment from equipment (accuracy in position)
(c) Kinds of power from equipment (operational characteristics)

(d) Existance and types of sensors from equipment
(e) Responsive speed from equipment
(f) Indication of size and weight of fingers
(g) Degree of maintenance of fingers

(3) Requirements of fingers from the aspect of environment

(a) Temperature range
(b) Humidity range
(c) Measures against dust and foreign matter
(d) Cutting oil. Measures against oil
(e) Measures against harmful substances (acid and alkali)

(4) Requirements for fingers from the aspect of operation

(a) Cost (and scrap value)
(b) Time limit of delivery and marketability
(c) Life
(d) Safety and reliability

What are the elements of fingers which will satisfy the above-mentioned requirements?

3. Elements of Fingers

Fingers at present are leaders of automation techniques and various typed have been developed to meet certain needs. No doubt the requirements mentioned in the above four items will stimulate engineers' desire for development of mechanical types of fingers which are most responsive to various needs. The reasons are that they perform three functions of "pick", "grasp" and "clasp", according to workpieces from small to large, and are adjustable for positioning and deformation for obtaining accuracy.

As contrasted to mechanical fingers, there are absorbent fingers, which utilize either vacuum or magnetism. Improvements in suitable techniques are widening their scope. Vacuum fingers produce more power than might be expected. However,

Legends for Figs. 1 ~ 13.

- : Movable support
- : Axial support of rotation
- : Claw of a finger or work clamping point
- : Coiled spring (tension type)
- : Coiled spring (compression type)
- : Driving power (electricity, oil pressure, air pressure, and mechanical)
- : Rack (pinion is by a circle)
- : Shows movement direction when clamped

Fig. 1.

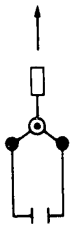

Fig. 2.

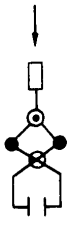

Fig. 3.

mechanical designers are reluctant to use them because of anxiety about what may happen if the vacuum is suddenly released. However, this is strange. If air pressure fails in a mechanical finger, the same thing will happen. Fingers utilizing vacuum and magnetism will be introduced in feature articles on another occasion. More specialized fingers are clamped with bands, utilize springs, or clamp fingers or the like, which are made of rubber or plastic. These will be also taken up in other feature articles.

Discussion here will be focused on mechanical fingers. They depend on four kinds of motive power as mentioned below:

(a) Electric type (motors and solenoids)
(b) Hydraulic type (oil pressure linear cylinders and rotary cylinders
(c) Pneumatic type (air pressure linear cylinders and rotary cylinders)
(d) Mechanical type (combination of coiled springs, cams, wires, etc.)

These are used in a single unit or in combination. They may be used depending on purpose or in accordance with power, requirements.

Other needs in using fingers include sensors. These are various kinds based on the use of electricity, air pressure and light. Sensors may be divided into the following four types:

(a) Presence (sense of touch)
(b) Location (sense of location)
(c) Strength (sense of pressure)

Out of these, the need for sensing the presence of work in (a) are the most in number for fingers used for industrial purposes and are concentrated on clamping. Location becomes a major point for mechanical fingers of precision parts, and the finger mechanisms become complicated. The sense of pressure in (c) is a sensor used for scratches and for work which may ship down or break when clamped forcedly. The sensor is very rare in industrial use.

4. Mechanism of Mechanical Fingers

Mechanical fingers are used extensively in industrial use and probably occupy about 80% of those used industrially. However, the mechanisms vary with different manufacturers. There are many disigned to suit specific purposes owing to the preference of designers and patent probelms. Designs put on the market by makers are mostly mechanical fingers, types of which have increased recently. A considerable number will be used in future years and they will become standard items.

Figs. 1 to 10 show basic types of mechanical fingers and Figs. 11 and 12 show basic attachments. All the figures show closed clamp type.

Fig. 1 does not require so much explanation. When a tapered section moves downward by the action of motive power and opens the movable supports having a rotational body, claws are closed around the axial support of rotation. This type is

relatively precise. However, if the tapered section fluctuates with respect to the center axis, deviation is caused and precision is not possible, as in a collet chuck. Another defect is that motive power extending upwards increases the total length and becomes a bar which does not allow other than lateral grasps.

Fig. 2 shows a typical link system in which clamping is by drawing the power upwards. Deviation at the movable support causes both claws to move separately and worsens clamping accuracy.

Fig. 3 also shows a link system as a Fig. 2. In this case, a downward force from above moves the claws in a clamping direction. The link systems change opening and closing freely with a number of supports.

Fig. 4 shows a rack and pinion type which drives claws simultaneously and with reliability. The power also moves upwards to clamp and when opened the rack withdraws towards the claws. This causes short claws to collide with the work. If the rack does not come between the claws, it should be arranged as in Fig. 5.

In Fig. 5, when power moves downwards, clamping takes place, the gears mesh with each other and accuracy is assured. However, backlash cannot be prevented in the case of gears and the force used is limited. The defect is also that dust and foreign matter clogs the gears in a environment, making the motion unfavourable.

Fig. 6 shows a type suited for compact fingers, which requires a little complicated working but is very convenient to use. However, it has a tendency to deviate to one side and thus cannot be used without further measures being taken.

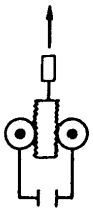

Fig. 4.

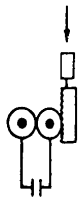

Fig. 5.

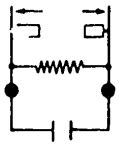

Fig. 6.

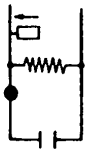

Fig. 7.

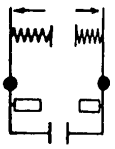

Fig. 8.

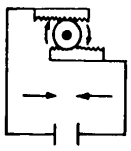

Fig. 9.

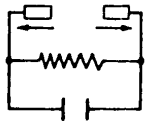

Fig. 10.

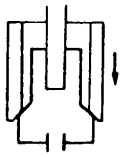

Fig. 11.

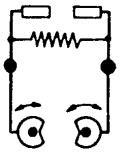

Fig. 12.

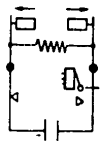

Fig. 13

Fig. 7 shows a type in which a claw on one side is fixed and only that side is opened or closed. In this case, the work is pressed to that side with high accuracy, attaining about ±0.01 of positioning. However, this is inconvenient in grasping the work and opening on both sides in more desirable in this respect.

Most of the above examples use motive power to close and clamp and have defects in that when the motive power fails for some reason, the work is dropped. Accordingly, the type shown in Fig. 8 is designed on the basis of reverse thinking in that it is clamped with a coiled spring and is opened when motive power is applied. The defect is however that a work must be such that it can be clamped with a coiled spring and that a motive power must be strong enough to open the force of that spring. Here is a contrivance with claws as in Figs.6 and 8 which meet at the center. The contrivance is that a stopper is attached to a claw on one side as if when closed that side is in a fixed state as in Fig.7. For this purpose, power for the claw on the fixed side is made greater and moves faster so that it arrives at the stopper before the claw on the pressing side reaches the work. Clamping force acts on one side only and does not cause errors.

Fig. 9 shows a rotational body used as motive power by which fingers make a parallel movement for clamping. The above-mentioned fingers have made an Rθ movement for clamping but this type causes parallel movement and as a natural consequence complies with a desire to grasp gently. This is also a type in which claws are moved by rotational movement, and has an advantage that it is compact as compared with open angles or open dimensions. However, the cost becomes a little higher.

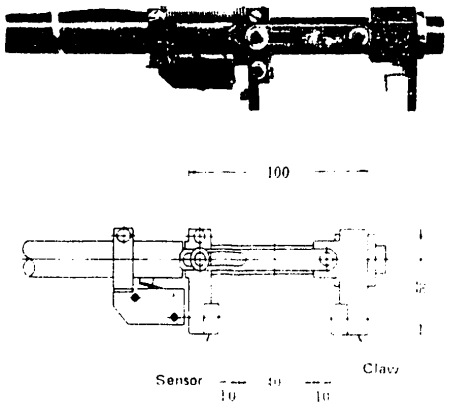

Photo 3. Example of a Linear Clamp

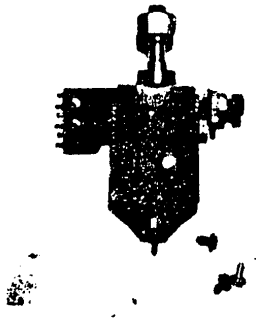

Photo 4. Finger for Precision Parts

Fig. 10 shows what has been developed for the same purpose as is Fig. 9, which uses motive power and a coiled spring instead of a rack and pinion. It has the same defect as in Figs. 6 and 8 in that both claws do not meet. A way for solving this problem is the same as in Figs. 6 and 8.

Fig. 11 is entirely different from the types mentioned above. This type is called a collet chuck type. In its simplest form, the chuck is provided with a spring and is held by friction only. The collet chuck type must have a simple form such as a round bar and rectangular bar and the precision is very high with a deviation coming within ±0.01. The only defect is that the amount of opening is small and a jamming phenomenon causes the work to stick, preventing it to fall down and release. It is accordingly desired that an extruding pin should be provided extending from the center to eject the work.

Fig. 12 shows a contrivance of a type in which the claws make an Rθ motion to clamp. It is provided with an equalizer at the end of a claw. When the center of a work deviates a little, it never fails to be brought to the center at the clamp. Instead of doing so, it has been devised to grasp softly or to register at the center by providing a rubber pot or cantilever spring at the tip of the claws.

Fig. 13 is a kind of sensor, which issues a signal at the failure to grasp work when clamped on in the work's absence. That is, a claw shifts more to the center at the absence of a work and passes the position where the work usually exists, and thus collides with a limit stopper. In this instance, it strikes a limit switch to issue a signal. This is the most inexpensive detecting method. Other detecting methods are that a weak electric current is used to be passed when a limit stopper is struck, or that an air sensor, a magnetic sensor or thermal sensor is provided at the tip of a claw.

5. Conclusions

Above is a feature article on mechanical fingers which are the most popular of fingers at present and have a high rate of applications. It is scheduled next time to feature such fingers as those that clamp thin work or soft work.

Differences of automation techniques from conventional mechanical techniques are divided largely into three.

The first is to make the five senses represented by eyes technological. Arrangement of work becomes a parts feeder and judgement of existance is a sensor. The second are controls replacing the brains, which carry out program controls and adaptation controls with minicomputers and microcomputers – the most progressive techniques at present. The third will be fingers for "grasping techniques". It would therefore be necessary that stress is placed on the development of fingers which are important in automation techniques.

CSO: 4120

SCIENCE AND TECHNOLOGY

HOMOLOGATION OF METHANOL CATALYZED BY MIXED TRANSITION METAL CLUSTERS CONTAINING COBALT

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 pp 43-44

[Text]

Syntheses of mixed transition metal clusters containing cobalt and their catalytic activities for homologation of methanol were investigated. The reaction of $RuCl_3$ with $Na[Co(CO)_4]$ gave a reddish brown complex $Na[RuCo_3(CO)_{12}]$. The cluster easily underwent a cation exchange to give Cs^+ and $[Et_4N]^+$ salts. These clusters showed a remarkable catalytic activity for homologation of methanol. The selectivity of ethanol was increased up to 51% in ca. 40% conversion in case of $[Et_4N]^+$ salt. Catalytic activities of some other mixed metal clusters were also examined.

Current energy and resources crises emphasize the potential increased availability of synthesis gas from gasification of coal and other carbon resources.[1] This has spurred a number of researches of the catalytic formation of useful chemicals from synthesis gas by using heterogeneous[2] and homogeneous[3] catalysts. M. Hidai et al. (University of Tokyo) have now started their studies on the reaction of methanol with synthesis gas, i.e., homologation of methanol to ethanol (equation 1), n-butanol, or higher alcohols because methanol is easily derived from synthesis gas.

$$CH_3OH + CO + 2H_2 \rightarrow CH_3CH_2OH + H_2O \quad \text{.....(1)}$$

Since the first report on homologation of methanol by Wender et al.,[4] many studies have been done by using cobalt or cobalt-iodide systems as catalysts.[5] However, the yield and the selectivity of ethanol were relatively low. Recently it was claimed that employing a CoI_2-PR_3 system as catalyst and octane as solvent, achieved selectivity for ethanol up to 89.4% at low conversion (13.2%).[6] There are also reports and patents dealing with the direct syntheses of ethanol by using rhodium carbonyl clusters supported on SiO_2, TiO_2, or ZrO_2.[2] Their studies are now focused on finding mixed transition metal catalysts which are effective for homologation of methanol, since a combination of the different metals in mixed metal clusters may show reactivity patterns significantly

different from homo-clusters. Although many transition metal clusters including mixed metal clusters have been prepared and their structures have been determined by X-ray analyses,[7] only a few clusters were found to be effective for catalytic reactions.[7][8] Rhodium carbonyl clusters, for example, showed significant catalytic activities for addition of arenes to ketene or isocyanates,[9] synthesis of ethylene glycol,[3a] and oxidation of alcohols and ketones.[10]

They have now prepared mixed transition metal clusters of cobalt and other transition metals cince cobalt is known to be effective for homologation of methanol and the combination with appropriate metals is expected to give a more effective catalyst. The following mixed clusters were first prepared according to equation 2.

$$[(dpe)MCl_2] + 2Na[Co(CO)_4] \rightarrow [(dpe)MCo_2(CO)_7] \quad \text{..... (2)}$$

1 : M = Pd, 2 : M = Pt

dpe = $Ph_2PCH_2CH_2PPh_2$

When a THF solution of $Na[Co(CO)_4]$ was added to the suspension of $[(dpe)MCl_2]$ (M=Pd,Pt) in THF, the color of the solution immediately turned dark red, and the mixture was allowed to stand at 50°C for 2 hr. After filtration, the solution was evaporated to dryness and the residue was recrystallyzed from CH_2Cl_2/hexane to give $[(dpe)PdCo_2(CO)_7]$ 1 or $[(dpe)PtCo_2(CO)_7]$ 2 in good yields (1; 89%, 2; 78%).[11] The cluster 2 has previously been prepared by the same method.[12] The compound 2 was also prepared by the reaction of $[(dpe)Pt(-C{\equiv}CPh)_2]$ with $[Co_2(CO)_8]$. The infrared spectra of these clusters 1 and 2 showed three terminal ν(CO) at 2040, 2000, and 1979 cm^{-1} and one band at 1720 cm^{-1} which is ascribed to a bridging carbonyl group.[13] The results of homologation of methanol by using these mixed clusters are shown in Table 1. In the case of the cluster 1, the rate of methanol carbonylation to acetaldehyde increased compared with $[Co_2(CO)_8]$ or $[Co_4(CO)_{12}]$, but the reduction to ethanol was not enhanced. On the other hand, use of the cluster 2 slightly increased the yield of ethanol. When the cluster $[RhCo_3(CO)_{12}]$[14] was used as catalyst, the yield of methyl acetate slightly increased.

Preparation of a mixed cluster containing cobalt and ruthenium has also been attempted since there are some claims that the yield of ethanol is improved by the addition (Ru/Co ratio=ca. 1/10). When a red solution of ruthenium chloride in methanol was treated with an excess of a THF solution of $Na[Co(CO)_4]$, the color of the mixture immediately changed dark blue. The mixture was allowed to stand at room temperature for 10 hr. After the color of the mixture turned dark red, the solution was evaporated to dryness and the residue was extracted with THF. After evaporating the solvent, a reddish brown compound was obtained. The solid was recrystallyzed from THF/hexane to give $Na[RuCo_3(CO)_{12}]$3 in 68% yield.

Table 1. Homologation of Methanol Catalyzed by Mixed Transition Metal Clusters[a)]

Catalyst		Conversion (%)	Yield (%)[b)]					Selectivity (%)[c)]	
			AcH	DMA[d)]	EtOH	AcOMe	Me_2O	Total C_2	EtOH
$[Co_2(CO)_8]$[e)]		46	3.9	25	0.7	2.5	22	31	1.4
$[Co_4(CO)_{12}]$[f)]		48	4.0	29	0.6	2.8	23	32	1.2
$[(dpe)PdCo_2(CO)_7]$;[e)]	1	61	10	30	0.8	5.9	18	39	1.3
$[(dpe)PtCo_2(CO)_7]$[e)]	2	49	6.0	24	1.6	3.7	19	33	3.3
$[RhCo_3(CO)_{12}]$		52	6.0	27	0.8	8.4	16	39	1.6
$Na[RuCo_3(CO)_{12}]$	3	46	1.3	5.6	16	4.4	20	41	30
$Cs[RuCo_3(CO)_{12}]$	4	43	0.7	2.6	18	5.6	16	51	41
$[Et_4N][RuCo_3(CO)_{12}]$	5	41	0.5	1.7	21	0.4	15	54	51
$[Et_4N][Ru_3Co(CO)_{13}]$[f)]	6	40	0	0.4	9.1	2.6	27	26	23
$[Ru_3(CO)_{12}]$		18	0	0	2.8	0.7	31	11	10

a) Unless otherwise noted, the catalyst (0.13 mmol), methanol (500 mmol), CH_3I (5 mmol), and benzene (10 mmol) as internal standard were charged in a 200 ml stainless-steel autoclave lined with titanium. Carbon monoxide (40kg/cm^2) and hydrogen (80kg/cm^2) were then introduced and the mixture was stirred for 3 hours at 180°C. b) The yield was calculated by (CH_3OH consumed for product)/(CH_3OH charged) x 100. c) The selectivity was obtained by [product(mmol)]/[CH_3OH reacted(mmol)] x 100. d) DMA means acetaldehyde dimethylacetal. e) The amount of the catalyst used was 0.2 mmol. f) The amount of the catalyst employed was 0.1 mmol.

$$RuCl_3 \cdot 3H_2O + \text{excess } Na[Co(CO)_4] \rightarrow Na[RuCo_3(CO)_{12}] \quad (3)$$

The addition of CsCl or $[Et_4N]Cl$ to a water solution of the cluster 3 precipitated a brown solid which contains Cs^+(5) as a cation.[16] A similar mixed cluster $[HRuCo_3(CO)_{12}]$ was previously prepared by the reaction of $[Ru_3(CO)_{12}]$ with $[Co_2(CO)_8]$ in acetone followed by acidification with hydrochloric acid, but the yield was only 7%.[17] The infrared spectra of these clusters 3, 4, and 5 exhibit absorptions at 1990, 1960, and 1,800cm^{-1} characteristic of carbonyl ligands, which are very similar to those of an iron-cobalt cluster $[Et_4N][FeCo_3(CO)_{12}]$.[18] The cluster $[HFeCo_3(CO)_9[P(OCH_3)_3]_3]$ has a closed metal tetrahedron with three bridging carbonyl ligands between the each two cobalt atoms.[19] Based on the similarity of the infrared spectra (vide supra), it may be reasonable to postulate the structure of $[RuCo_3(CO)_{12}]^-$ to be similar to that of the above iron-cobalt mixed cluster.

Compared with $[Co_2(CO)_8]$ or $[Co_4(CO)_{12}]$, the mixed clusters 3, 4, and 5 showed remarkable catalytic activities for homologation of methanol as shown in Table 1. It is to be noted that the yield and the selectivity of ethanol depend upon the counter-cation. The cluster 5 gave a liquid product mainly composed of ethanol and the selectivity of ethanol was 51% at ca. 40% conversion. The other cobalt-ruthenium mixed cluster $[(Ph_3P)_2N][Ru_3Co(CO)_{13}]$ recently prepared by Geoffroy et al.,[20] gave ethanol in over 9.1% yield, but the selectivity was rather low. Work is now in progress to elucidate the reaction mechanism.

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CSO: 4120

SCIENCE AND TECHNOLOGY

INCREASING DEMAND NOTICED FOR VARIABLE SPEED MOTORS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 pp 45-46

[Text]

It is not only in recent years that the need for attaining variable speeds of motor has been recognized. The fact that control of the primary voltage of an induction motor varies the number of rotations was known in the days when the invention had just been made. In the production field, this knowledge has been utilized for ever increasing productivity. For example, the speed of conveyers is varied in accordance with the dextrity of the employees on the assembly line of a factory. Variable speed motors have found many such uses.

However, it is from the viewpoint of energy saving that variable speed motors are now in the spotlight. It has been ascertained that they unexpectedly effect energy saving and that they pay for themselves in a very short time. In the USA, the Energy Department is promoting the high efficiency of three-phase sauirrel-cage induction motors and has set a standard (NEMA · MEGIO) as a guide for enforcing effective energy saving by motors, and is taking a new look at the use of motors. Hereafter, stress will be placed on software, as to its selection and use, such as what kinds of motors are best used for reducing electric power consumed. The way of thinking should also be changed from considering the initial cost first to the total cost first, including running cost.

Industrial motors are used everywhere. Careful examination of their uses has found that there are not a few cases where they are continuously operated under a given load, and further that there are quite many cases where the load varies with time and season. The use of a constant speed motor for such variable loads lowers efficiency with a decreased load and also does not serve to save energy because of the unvariable capacity of the motor. Contary to this, the use of a variable speed motor permits the output of the motor to be lowered by lowering the speed of the motor with a decrease in the load. Accordingly, a decrease of motor efficiency at lower speeds is compensated for by a comparable decrease in the output, whereby energy saving is attained.

Therefore, a user using a constant speed motor for a variable load should change the motor itself for a more efficient one, energy saving can be attained by the following methods: (1) it should be replaced by a variable speed motor; (2) an inverter should be interposed between the conventional constant speed motor and the commercial electric source for obtaining frequencies corresponding to the load so as to change the rotation number of the motor, etc.

There are many kinds of variable speed motors, including a primary voltage control motor which controls the input voltage of a conventional induction motor (Squirrel-cage AC motor). It is necessary to select the type most suitable for the user. The recent trend however highlights a system for controlling speed with inverters, and it is frequently used for conventional squirrel-cage induction motors. It is also noticed that super-precision rotational control is attained by combining it with synchronous motors and that high-speed rotation is attained by combining it with high-frequency motors.

This inverter is briefly a device by which the frequency of an electric source can be varied. It is generally called a variable frequency inverter. Its mechanism is that commercial AC is full wave rectified by an inverter (so-called rectifier) to obtain DC with few pulsations, which is thereafter converted into AC of variable voltage and variable frequency. When an induction motor is controlled by this method, its own solid structure and brushlessness do not require any maintenance. Moreover, the low price makes it favorable with the need for energy saving and maintenance-free equipment in industries centering around the steel industry.

Types of inverter include voltage types, current types, and pulse width modulation (PWM) types. What most companies are now giving their attention to is a PWM variable frequency inverter. It is reported that the recent start of quantity production of large-capacity GTO (Gate Turn-Off) thyristers has rapidly promoted its practical use and has made it possible to effect control of high efficiency and wider range (about 1 to 109) by operating a knob (frequency control). Especially, the use of the PWM control method has elevated the power factor of the electric source so that noise and power factors have little influence on the electric source. Further, improvement in output wave shapes at lower speed ranges and reduction of higher harmonics have reduced the heat generated by the motor itself. Most motor manufacturing companies have already started production of these inverters, most of which can be used not only for general induction motors but also for totally-enclosed motors, explosion-proof motors and corrosion-proof motors. The small size and light weight allow them to occupy smaller space for installation.

Thanks to its numerous merits, it has already been introduced for sheet metal cutters, winding machines, stretchers, and other metalworking machines, conveying machines such as conveyers and feeders, bandsaw mills, woodworking machines, wood laminating machines, machines for use in agriculture,

forestry and fisheries, plastics working machines, etc. A system by which a set of inverter units carries out speed control for several motors has been put into practical use for spinning machines by which a number of small-capacity induction motors is employed for winding and traversing.

There are many kinds of variable speed motors besides those using inverters. Each company in the industry is doing its best to strengthen its line-up of inverters. However, the inverter is not everything.

From all the kinds of variable speed motors, the most handy and that with the lowest cost is the primary voltage control type. Its input does not correspond to the reduction of speed and this is why it is not called an energy saving type. However, it is still in big demand for pumps, fans etc. which have square reduced torque characteristics and require stepless speed change, or for conveyers, hoists, twisting machines, etc. which have constant torque characteristics at varied rotational numbers and require stepless speed change. Recently, types exclusively used for blowers and pumps, which have the same fixing dimensions as that of wide-use motors have been manufactured and are easily substituted for wide-use motors.

Another conventional system frequently used is the eddy current coupling system, which is considered to occupy more than half the demand for variable speed motors when joined with the primary voltage control system. In this system, an induction motor is directly connected with an eddy current coupling and PG (speed detecting AC generator), and thereby transmission torque from the motor is controlled by controlling the excited current of the eddy current coupling so as to maintain a set speed even when the load varies. Despite its low energy saving effect, it has a wide range (1 to 10) of speed control and is inexpensive. It is therefore considered that there will be a big demand for it for such loads as in pumps, fans, conveyers, winders, crushers, centrifugal casting machines, etc., which have constant torque characteristics at varied rotational number and require stepless speed changes.

In the field of DC motors, the thyrister Leonard system will be used for work that requires a wide range of speed control, because of its adventageous economic factor and its high reliability. It is mainly used for NC machine tools. The demerits inherant in DC motors, that is, the fact that the existance of a brush makes their maintenance difficult, have obliged a shift to AC motors in some uses. Thyrister motors, in which thyristers are substituted for the rectifying mechanism of a DC motor, have been welcomed because of their good reliability and wide control range in general industries, for iron manufacture, etc. The secondary resistance control system obtaining a variable speed for wound-rotor type motors has been welcomed for the winding of a crane which involves a high frequency of starting operation. Its merit is the inexpensive initial cost, while its demerit is that it takes time from the start up the motor simultaneously with a constant speed induction motor to arrival at constant speed operation. It therefore involves a little difficulty when used as a high-degree variable speed motor.

CSO: 4120

SCIENCE AND TECHNOLOGY

TEST ENZYME REACTOR COMPLETED

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 pp 46-48

[Text]

The manufacture of a test enzyme reactor which was ordered by the Institute of Physical and Chemical Research from Sagami Chemical Research Center, Toyo Soda and Mitsui Information Development, promoted under the leadership of Prof. Wada of Science Department of Tokyo University, has recently been completed.

The test enzyme reactor is intended to standardize, like semiconductor, the characteristics of enzymes which are essential to reaction systems being the heart of an engineering bio-reactor. It has sufficiently high functions to obtain ample data with strikingly much higher speed and accuracy than by manual studies. Thus, it is expected to serve as a laboratory automation method.

The Institute of Physical and Chemical Research has since 1977 been pursuing research of bio-reactors.* One of the purposes of this project, at present, is the trial manufacture of a polypeptide type tester which is able to automatically synthesize polypeptides useful to human beings. The Institute intends to manufacture test bio-reactor No. 1 by the end of 1983 to synthesize a peptide with about 10 amino acids combined, and in 1986, the last year of the project, to synthesize a peptide with 20 amino acids combined.

The greatest technological aspect of bio-reactors is enzymes which act as catalysts in the combination of amino acids. The bio-reactor under study, in particular, is a type which has several reaction systesms placed under computer control and which is designed to obtain peptides for industrial use in the future. The least requirement for it is to stabilize the characteristics of enzymes for live materials.

The new test enzyme reactor has been made to standardize enzymes in order to understand the characteristics of enzymes under individual conditions, and obtain stable enzymes.

Test enzyme reactor No. 1 just disclosed, is a computer controlled automatic measuring instrument which follows peptide dissolution reactions using various types of protease, makes clear the characteristics of protease such as reaction speeds and requirements for solvents and retrieves optimal conditions for peptide synthesizing reactions using inverse reactions.

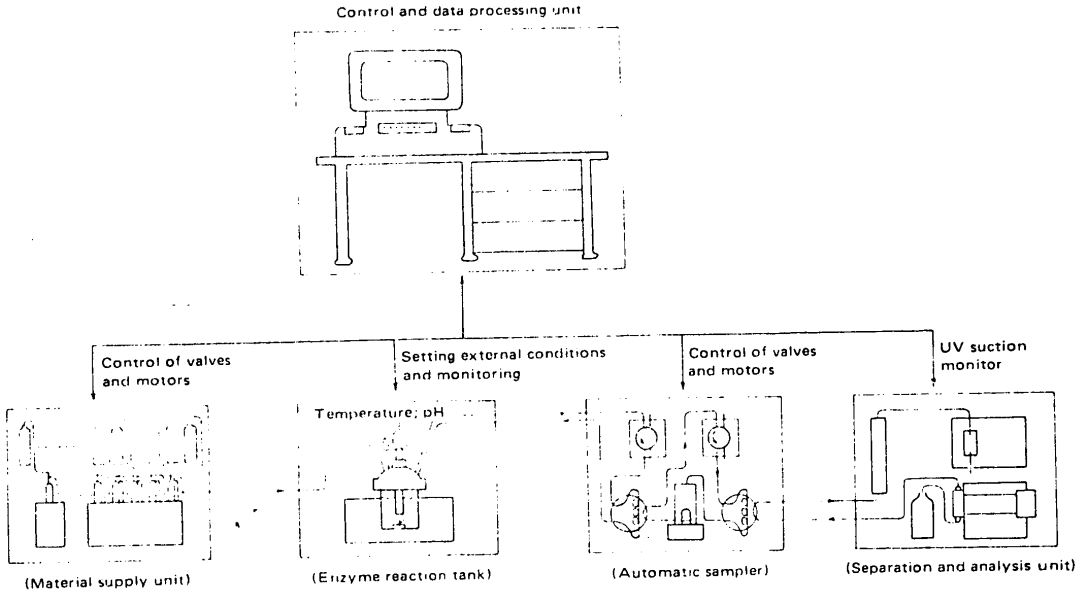


Fig. 1. Structure of Test Enzyme Reactor System

The reactor consists of an enzyme reaction tank, a material supply unit, a separation analysis unit and a computer to control the entire system and perform data processing.

Measurement will be under the following conditions. Temperature range: 0–50°C; pH: 1–14; controllable interval: 0.1°C and 0.1 pH; analysis frequency: once per 10 minutes, Manual examination of enzyme reactions takes much time, does not allow an increased number of conditions to be used, and what is more fatal, fails to ensure accuracy. In full operation, the new system processes 200 samples a day, and provides stereo-scopic and correct data under all conditions. Thus, it is an entirely new system of laboratory automation in the world.

Also, the system, in which enzyme reactions are reversible between dissolution and synthesis, enables 2 kinds of amino acid to be synthesized and is expected to serve as a predecessor of the ultimate bio-reactor.

The attempt to understand the characteristics of enzymes nearly completely, attain as high stability as that of ordinary elements and thus prepare for future synthesis of peptide is unprecedented in the world and is attracing the attention of researchers overseas as well as at home.

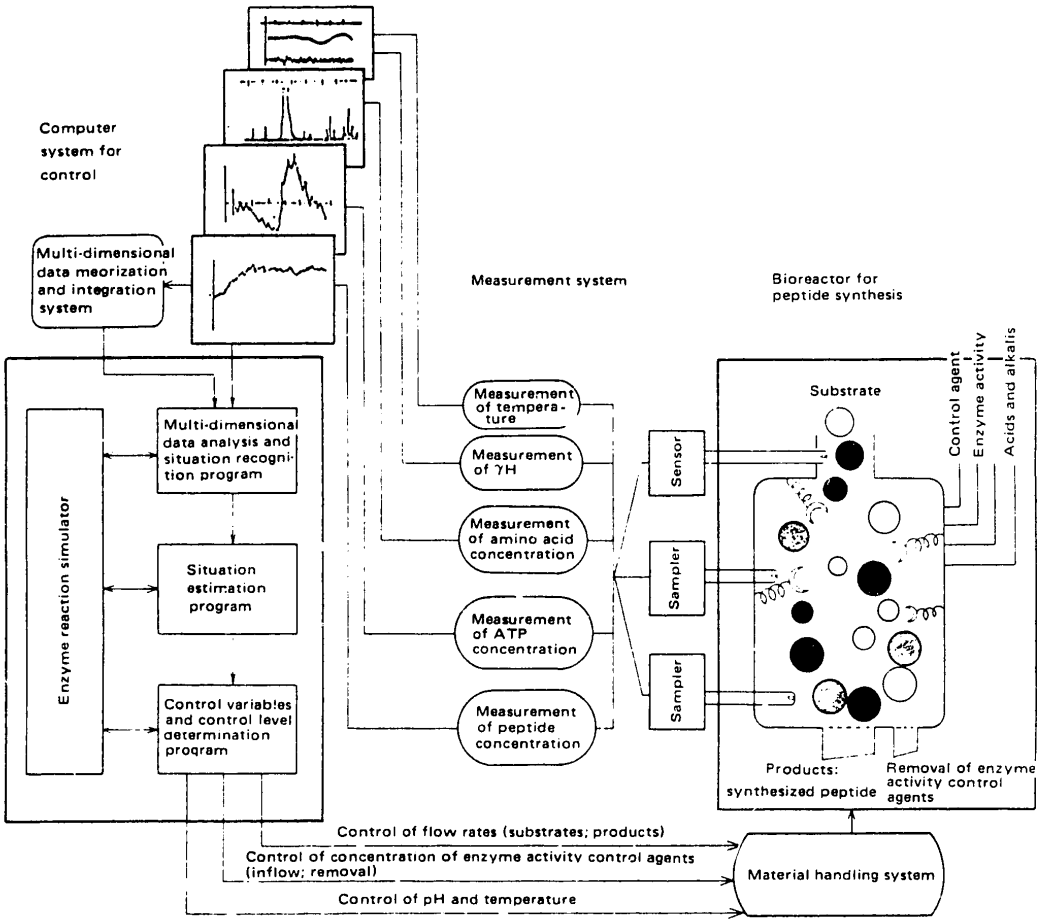


Fig. 2. Techniques for Measurement Control and Material Handling in Bio-Reactor

The Institute intends to complete, by the end of 1983, a bio-reactor which is able to synthesize peptides containing up to 10 amino acids and by the end of 1986, a bio-reactor which is able to synthesize up to 20 amino acids.

The bioreactor is an advanced chemical-reaction system with techniques for allowing various materials to be synthesized and dissolved by skillfully combining enzyme reactions after the fashion of chemical reactions in biological entities integrated with techniques for measuring and controlling such reactions optinally.

Bioreactors currently under study include peptide synthesis type which synthesize peptides from amino cids by making use of enzyme reactions and diagnosis types which are designed to serve in medical applications such as measurement of components of blood, etc. with high accuracy. The test enzyme reactor described here is intended to develop bioreactors for synthesizing peptides.

CSO: 4120

SCIENCE AND TECHNOLOGY

SEMIPLANAR JOSEPHSON JUNCTION DESCRIBED

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 pp 49-52

[Text]

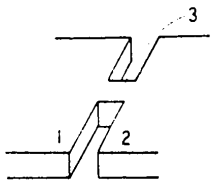
The Institute of Physical and Chemical Research has experimentally manufactured a junction of a new structure called a semiplanar Josephson junction. Reportedly, the Institute has proved by examining its microwave response, that the new junction has excellent electrical characteristics. While it shows high performance and has a long life, the junction is easy to mass-produce and this is expected to contribute greatly to making Josephson junctions practically usable. Apparantly, the experimentally made junction has a weak tie only 0.075μ long and has an electrostatic capacity of only about 0.04pF. Also, it achieves over 0.3mV for the production of critical current and resistance, is highly resistant to thermal cycles between room temperature and the temperature of liquid helium and has a life of more than 1 year in room temperature and in the atmosphere.

1. Features of Semiplanary Junction

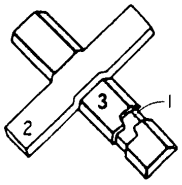
Fig. 1 shows a variety of Josephson junctions. They have a structure consistiof 2 super-conductors (indicated by 1 and 2) electrically weakly connected together with a certain substance (indicated by 3). Operable at the temperature of liquid helium, they act as non-linear inductances. A semiplanar junction is shown in Fig. 1.(e). In its structure, this is a hybrid of the [3] most typical conventional Josephson junctions (a) a superconductive microbridge (c) a thin-film tunnel junction and (g) a point contact junction. The semiplanar junction was born as a development of superconductive microbridge types.

The superconductive microbridge junction consists of a single superconductor which is made by micro-machining a weak tie less than 1μ long and wide. This junction, however, has a narrow range of working temperatures and is hard to handle because it is easily broken by charges in the discharge from a human body.

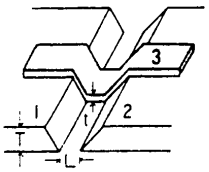
An improved version of this is shown in (b). Because of its structure, it is called a planar Josephson junction. If the thickness t of the weak tie (3) is made sufficiently smaller than



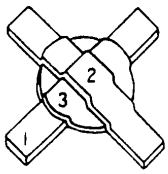
(a) Superconductive microbridge



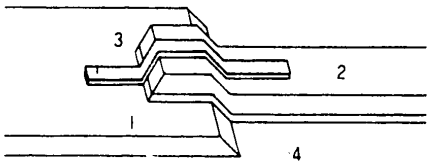
(c) Thin-film junction



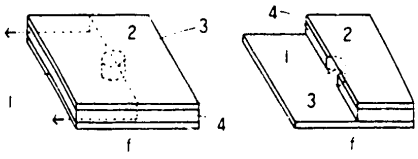
(b) Planar junction



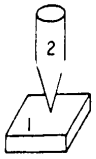
(d) Sandwich junction



(e) Semiplanar junction



(f) (f') Point-contact bridge



(g) Point-contact junction

1: Superconductor (electrode)
2: Superconductor (electrode)
3: Weak tie (or barrier)
4: Insulator (spacer)

Fig. 1. Various Josephson Junctions

the thickness T of the super-conductive electrodes (1 and 2), the position near the weak tie between the electrodes 1 and 2 will be little affected by the current; though the weak tie will not lose its super-conductive characteristics, but will have electrical junction characteristics greatly improved, and will have its range of working temperatures widened.

Again, the planar Josephson junction permits the selection of any material for the weak tie (3). If bismuth, which has large specific resistance, is selected, the weak tie, even about 40μ wide, provides an electrical connection which is not too strong and an element with high performance can be obtained. A weak tie 40μ wide is less likely to be broken by discharge from the human body than a weak tie less than 1μ wide. A current flows through the bismuth tie between the super-conductors 1 and 2 and the bismuch tie on the super-conductors will have not effect upon anything.

In addition, the planar junction was also devised by the Institute and was used as a basis for the semi-planar junction.

The key point in obtaining high-performance junctions is to minimize the length L of the weak tie. It is impossible to make a slit less than 0.1μ in a film of super-conductive niobium which is 0.2μ thick and which has low mutual diffusion with bismuth, even by making full use of electron beam lithography and the most advanced techniques of micro-machining which have been developed for ultra-LSI elements.

However, this is not always true of the new structure shown in (e) in Figure. The effective length of the bismuth weak tie which connects the two niobium forks 1 and 2 depends on the thickness of the rock crystal film (4) which is used as a spacer (insulating layer). If the rock crystal is 0.075μ thick, it is equivalent to a 0.075μ groove provided in a 0.2μ niobium film, and this is considered to have overcome the limitations of micromachining techniques.

The film tunnel junction (c) is the element which IBM has been applying in computer circuits. Although it shows high performance, it is not sufficiently resistant to thermal cycles between the temperature of liquid helium (working temperature) and room temperature. When left in the atmosphere at room temperature, it will gradually lose its characteristics. These drawbacks arise because the weak tie (3) consists of a very thin plumbum oxixe layer about 50Å (a stack of 10 stoms).

If it is desired in the manufacture of computers that irregularities of characteristics of junction elements be restricted to within 10%, it is necessary to control the thickness of the plumbum oxide films within an accuracy of 0.2Å. 0.2Å equals 1/5 of the diameter of the smallest atom hydrogen.

Therefore, it is a natural outcome that a sandwich-type Josephson junction, made by using a semiconductor or a metalloid, instead of by insulating plumbum oxide for the weak tie, has emerged. In the sandwich junction, using a metalloid tellunium as the material for the weak tie, the tellurium film is 400Å thick, or 10 times thicker than a plumbum oxide tie, and has static capacity several times smaller than the equivalent tie. The 400A tellurium film (3) has a number of pinholes, as shown in Fig. 2. If the surface of the tellurium film is oxidized

before vapor deposition on the superconductor (2), in order to prevent the superconductor from short-circuiting through the pinholes, it will fill in the pinholes but will also simultaneously oxidize the surface of the tellurium tie.

Current flows from the superconductor (1) to the tellurium tie (3), the oxidized tellurium and the superconductor (2), as indicated by the arrows in the Figure. The presence of tellurium thus oxidized can cause irregularity of characteristics.

If, for the semiplanar junction, the rock crystal is oxidized to fill in the pinholes, as shown in Fig. 3, current does not flow from 1 to 4 and 2 but flows from 1 to 3 and 2, as indicated by the arrows in the Figure. This will cause characteristics not to be limited by the presence of oxidized tellurium or oxidized bismuth.

The reason for this is that in the semiplanar junction, the functions of the spacer (4) which spaces out the 2 superconductors are completely separated from those of the weak tie (3) through which current flows. This is in contrast to the arrangement of the sandwich type.

Recently, tellurium and germanium films free of pinholes have been made available. For the sandwich structure, however, the superconductor electrode (2) has to be fitted on the very thin tellurium or germanium film without tearing it. For this purpose, vapor deposition of a lead alloy with a lower melting point is used.

In the semiplanar junction, the rock crystal spacer is sufficiently strong to make it possible to use niobium, which has a long life, as a superconductor on it. Even if the rock crystal spacer is torn while the niobium superconductor is fitted on it, a liquid-helium test can be effectively conducted to sort out short-circuited superconductors before the weak tie (3) is fitted.

Because of the difference in the level of mutual metallic diffusion, the niobium-bismuth-niobium junction has a life expectancy at room temperature more than 100 times that of the lead-bismuth-lead junction.

The point-contact junction (g) is unstable in mechanical vibration, though it is very high-performance element. In order to eliminate this drawback, a point-contact bridge (f) using a film has been made. Imagining a structure made by cutting off dotted-line portions in f, we have a structure f'. This is similar to the semiplanar type e. Like the point-contact bridge, the semiplanar junction has a nearly ideal geometrical figure with an almost infinite "thickness" in the direction vertical to he axis of the weak tie of the superconductor electrode. Furthermore, the semiplanar element has the advantages of being easier to make than the point-contact bridge and of permitting free selection of weak tie materials.

Again, the semiplanar junction has other prominent features as follows. In the microbridge and the point-contact junction, a weak connection between 2 superconductor electrodes is attained by geometrically narrowing the portion of one superconductor, while in the thin-film tunnel junction an insulator is used as the material for the weak tie, and a weak connection is attained by making use of the properties of this material. In contrast, the semiplanar junction attains a weak connection not

only by using bismuth for the material of the weak tie, to make use of its properties, but also by geometrically narrowing a portion of the system. Thus, this type is expected to show the best performance.

Furthermore, the semiplanar junction can be made by stacking films through use of resistance masks, and it thus does not recessarily require electron beam lithography.

2. Semiplanar Junction Experimentally Made

Photo 1 shows a practical junction directly before a weak tie (bismuth) is fitted. In the portion resembling a "fan", noibium film is overlapped on a 0.075 μ thick rock crystal film. At the tip of the grip of the "fan", two niobium films meet with a rock crystal film between. The two niobium films are connected with a vapor deposited or spattered bismuth tie to form a junction. The smallest graduation in the Figure represents 10 μ.

Voltage-current characteristics obtained by applying 10 GHz microwaves to this trial junction are shown in Fig. 4. This indicates considerably high performance.

Photo 2 shows a "multi-target spattering system provided with analytic functions" which has been specially designed for manufacturing Josephson junctions as described above.

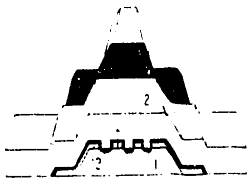


Fig. 2. Cross Section of Sandwich Josephson Junction

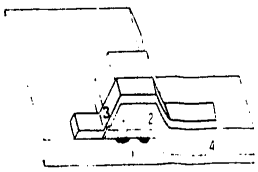


Fig. 3. Cross Section of Semiplanar Josephson Junction

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW AUDIO SYNTHESIS METHOD DESCRIBED

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 pp 53-55

[Text]

Musashino Electrical Communication Laboratory of Nippon Telegraph and Telephone Public Corp. invented PARCOR method of audio systhesis by a characteristic parameter in 1969. However, it has recently devised a new method called the LSP (Line Spectrum Pair) method which is superior to PARCOR. The laboratory has also succeeded in integrating an LSP audio synthesizer on a single chip, which reduces size and price.

1. Vocalization Mechanisms of Man and LSP Synthesizer

In the vocalization mechanism of man, a pulse-like sound wave is generated as a result of vibration of the vocal cords in the throat, caused by air sent from the lungs and passing through the trachea. This pulse sound cannot produce a distinguishable vowel or consonant. But, as the sound is going through from the throat to the nose, it changes into a speech sound recognized as a word. This is because a resonance frequency of the oral cavity is changed by the vocal organs, chin, tongue, and lips, to give phoneme a specific tone quality.

The passage of a speech sound from the throat to the lips can be compared to an acoustic pipe whose cross-sectional area changes with the position. The cross section is varied in shape by motion of the vocal organs. While the outer end of the pipe is open, the end on the throat side opens and closes as the vocal cords vibrate. Then, when this is simplified by replacing the throat-side conditions with two boundary conditions of being completely open or blocked, a pair of resonance frequencies are determined by the respective boundary conditions. This pair of frequencies is called a line spectrum pair (LSP). It is known that the cross-sectional shape of an acoustic pipe is uniquely determined by LSP.

Audio synthesis based on LSP-parameters is as follows: The synthesizer is composed of a pulse generation circuit that initiates vocal cord vibration, a noise generation circuit to initiate turbulent noise for a voiceless sound, and a filter to initiate the resonance characteristic of the acoustic pipe.

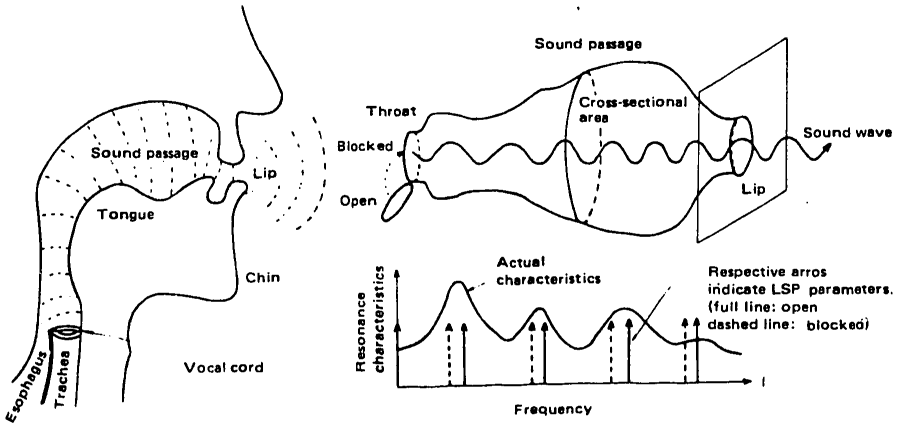
In the LSP synthesizer, information a pulse sound source and a noise source, an amplitude, a pulse period, and 8-10 LSP-parameters are input to the synthesizer.

2. Features of LSP

When a sound is expressed in terms of PARCOR or LSP parameters, the property of a parameter is determined by the following. The accuracy required in coding parameters, and the time intervals at which parameters must be updated. These are related to information content required for audio synthesis and quality of a synthesized sound, which is an important property of characteristic parameters.

Let us compare the new LSP method with the PARCOR method heretofore widely used, in the two points mentioned above. First, in the accuracy of parameter coding, 4-8 coding bits corresponding to types of parameters are necessary for PARCOR. In LSP, all parameters can be coded in about 4 bits. An experiment has revealed that the number of coding bits required in LSP is only about 80% of that in PARCOR when distortion of synthesized sound due to parameter coding is kept equal in both cases.

Next is an explanation of the update frequency of parameters. As a man vocalizes, a sound parameter varies all the time corresponding to motions of the vocal organs. While updating parameters at a high frequency of 200 cycles per second, a synthesized sound, with good tone quality



LSP parameters are defined as resonance frequencies corresponding to two boundary conditions in the throat, being open or blocked, in the acoustic pipe model.

Fig. 1. Vocal Organs of Man and Acoustic Pipe Model

and reflecting the organ motions can be obtained. In this case, however, greater information-content must be given to the synthesizer each second. Ordinarily, the update frequency is set at about 50-100c.p.s. But, this results in an unnatural sound.

Then, variations in the synthesized sounds are smoothed by interpolating intermediate parameters into those sent to the synthesizer sequencially. Errors in interpolation in LSP parameters are almost equal to those in PARCOR, even when the update frequency of LSP is reduced to 75% of that in PARCOR.

It can be seen from these facts that, in the LSP method, only 60% of the information required in PARCOR, which was formerly considered excellent, is enough to get almost the same tone-quality.

As stated previously, LSP-parameters are closely related to the resonance frequency of the sound passage, which is an important characteristic in view of hearing the correct sound. Therefore, they are suitable not only for parametric audio synthesis, but also law synthesis of an arbitrary word.

3. One-Chip C-MOS LSI

Though the LSP audio synthesis method has a number of excellent characteristics as described above, its utility value will be lowered if it needs a large and expensive synthesis device.

The laboratory has thoroughly examined a circuit system to produce the LSP audio synthesizer on a single LSI chip. An LSI for LSP audio synthesis has just been trial manufactured, and the expected performance has been ascertained.

This LSI has a number of excellent characteristics, which can be summarized with the following three points:

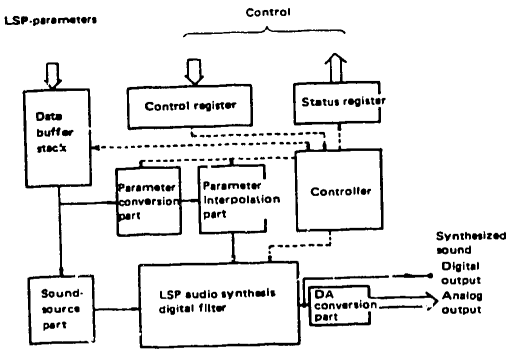
(1) A synthesized sound of superior quantity can be generated from a small amount of information. This is almost entirely due to the excellent LSP synthesis method, however, there various other devices must be considered. For example, the parameter update frequency can be adjusted to be a variation velocity of a sound parameter. The adjustment can decrease the update frequency by 25-40% without deteriorating the quality of the synthesized sound, and consequently even less information is required for the synthesis.

(2) The amount of power consumed is small, and the permitted range of power-source voltage is wide.. This has been achieved by using C-MOS technology. And all the operations necessary for parameter interpolation or realization of a sound-passage resonance filter are performed by the bit serial-arithmetic method. The circuit is designed so as not to produce any dead time, thus requires fewer gates and less power.

(3) The LSI has a fully flexible interface built-in to connect it to external devices. There are various applications for an audio synthesizer, and control using a microcomputer is required in many cases. The LSI has been designed, with the aforesaid point considered, so as to be directly connected with the bus of a general-purpose microcomputer. It also has a specially designed digital-analog(DA) converter in the sound output area so that a synthesized sound can be produced easily.

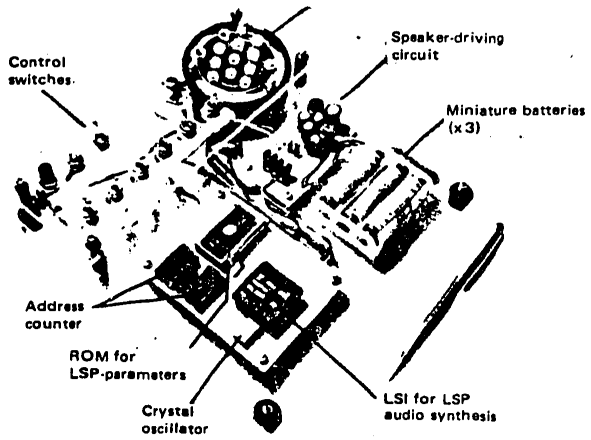
Table 1. Characteristics of LSI for LSP Audio Synthesis

Manufacturing technique	C-MOS
Scale of logical circuit	About 4,000 gates
Source voltage	3-6V
Current consumption (at 5-V source voltage)	5mA (on) 0.8mA (off)
Audio synthesis method	LSP (octal)
Information content	1.2, 2.4, 4.8, 9.6 kilobits/second
Internal arithmetic method	Pipe-line serial-arithmetic
Interface	8-bits parallel bus method
Synthesized sound output	8-bits analog output 16-bits digital output



After LSP parameters are deciphered in the parameter conversion part and are adequately approximated by polygonal lines, they are supplied to the LSP audio synthesis digital filter. Pulses or noises generated in the sound-source part are converted into sounds by the resonance function of the digital filter to produce a sound.

Fig. 2. Internal Structure of LSI for LSP Audio Synthesis



Laboratory Audio Synthesizer Using LSI for LSP Audio Synthesis (dimensions about 20cm x 20cm)

CSO: 4120

SCIENCE AND TECHNOLOGY

PRODUCTION OF 'CLEAN COAL'

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 56

[Text]

* Sanyo Chemical Industries, Ltd., as its research objective in its unique study program, is centering on the development of resources, and energy-related products. The company has recently established for the first time a "clean coal" preparation technique to pre-treat coal – again brought in focus since the oil shock – by granulation, ash removal, and desulfurization.

This so-called OA method (oil agglomeration) has been developed by the company ··pled with the Coal Mining Research Centre, ·n. The process can contribute to the ·ing of the environmental and transportaiton ·blems that have been barring the proper ·lication of coal like COM, and it is attract·in· interest as a revolutionary technology capable of boosting fuel efficiency.

For effective coal shipment, transport by 'slurry' is being highlighted as in it coal is ground up to form slurry with water, enabling transferal by pipe, the same method as is used with petroleum: the U.S. is already using the technique in some areas. When coal is burned, the impurities such as ash and sulfur which are profuse in it cause environmental pollution and other hazards. Consequently, coal cleaning techniques to eliminate those impurities efficiently are now under study in many countries.

The OA process that Sanyo Chemical and Coal Mining Research Centre group have developed can be utilized for the dehydration and cleaning of coal slurry.

The principle is that heavy oil is added to coal slurry and then stirred to help it to absorb the coal and to form granules, facilitating coal-water and coal-ash separation. In this unique method, the application of an additive while mixing will greatly improve granulation/ash removing effects. Experiments to date have revealed that the adding agent developed by Sanyo Chemical succeeds even with extremely small quantities: (1) halved heavy oil use; (2) streamlined granulation step with substantially quickened granulation-initiating time / higher slurry concentration / reduced impeller revolution; (3) greatly improved dehydration rate.

CSO: 4120

SCIENCE AND TECHNOLOGY

TOSHIBA ACCEPTS INFORMAL ORDER FOR MEXICAN 440MW GEOTHERMAL PLANT

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 56

[Text]

* Toshiba Corporation recently received via Mitsui & Co., Ltd. an unofficial order of Mexico Electric Power Authority for a world level geothermal power plant with a total capacity of 440,000kW. Geothermal power generation is one of the major energies which are alterantives to oil, and is under development by volcanic countries throughout the world. Although the capacity at the geothermal plants used currently by 13 nations, such as Japan, the U.S., and Italy, so far totals only approx. 4.3 million kW, counting both those which are running and those which have been ordered, this single giant facility will be capable of generating 10% of this total output. The negotiation are to build geothermal power plant in Mexico, consisting of four 110,000kW units. In Japan, the Mitsubishi group led by Mitsubishi Heavy Industries and Mitsubishi Metal Co. as well as the Fuyo group including Hitachi Ltd. and Marubeni Corporation are beginning to react in favour at another share in the market. Outpacing the others, the Toshiba-Mitsui party has struck up the tentative deal for a single, huge geothermal plant of unprecedented scale, thus demonstrating its overwhelming strength in this arena.

CSO: 4120

SCIENCE AND TECHNOLOGY

WORLD'S LEVEL WATER TURBINE CASING

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 57

[Text]

Fuji Electric Co., Ltd. is now building a 495MW Francis turbine, together with four 485,000kVA water wheel generators, for the Revelstoke power station of British Columbia Hydroelectric Generation Corp. in Canada. and it has recently completed a casing for the No.1 unit. The casing has an inlet diameter of 7.3m with the straight part of the inlet measuring as long as 12m; its runner diameter is about 7m, and consists of two portions. This installation not only provides a record large storage capacity but is also the leading structure of its type in the world. The Revelstoke power plant, located up the Columbia River, is capable of hydroelectric generation of a world-beating 2 million kW, and is expected for completion in 1984.

Earlier, Fuji Electric manufactured and delivered two sets of 306,000 kW units for BCH's Peace River power station, in addition to two 206,000kW units for Seihei pumped storage hydroelectric plant of Korea Electric Company.

Water Turbine Casing

CSO: 4120

SCIENCE AND TECHNOLOGY

MITSUBISHI TO DEVELOP COAL LIQUEFACTION

Tokyo TECHNOCRAT in English Vo 14, No 3 Mar 81 p 57

[Text]

Japan's largest business family, Mitsubishi, has finally entered the coal liquefaction field. Last October Mitsubishi Heavy Industries (MHI), in cooperation with Mitsubishi Corporation, Mitsubishi Mining & Cement Co., and Mitsubishi Oil Co., concluded the "Four-member Agreement on Joint-development of Coal Liquefaction" (provisional name). The Mitsubishi group will attempt to cope with liquefaction by the process called the "Soluborithis method", Japan's unique coal-liquefying technique which is one of the hopes of the Sun Shine Project being conducted by MITI's Agency of Industrial Science and Technology.

The Mitsubishi Corporation will be in charge of procuring foreign coal as well as coordinating the activities of the four companies: bituminous coal, including even sub-bituminous coal, is to be surveyed to draw a clear world map of all coal mines, including their scales. Mitsubishi Mining & Cement will check them to verify any developmental plans, and will analyse the quality of the coal. On the other hand, MHI is to construct a liquefaction plant, utilizing the knowhow accumualted while working on the soluborithis process commissioned by the governmental agency. Furthermore, the storage and handling of coal, related power generating facilities, and in addition anti-pollution equipment, are all in the scope of the firm. Meanwhile, Mitsubishi Oil will conduct the property analysis of coal-derived liquids, of the refining of the liquids, and will participate with the engineering department in a reforming of equipment and of the hydrogen :tion process—two of the vital elements in the liquefaction plant.

At present, a small-scale continuous coal liquefying facility with a processing capacity of 50kg per day is under construction by MHI at the request of MITI's agency, and is using a new process corresponding to the soluborithis method phase II.

This procedure, when started in 1974, was intended to make effective use of asphalt (the substance long regarded as a nuisance) for coal liquefaction. Although this led to the completion of the system employing asphalt solvent the redoubled oil crises have entirely upturned the relative value of the material. The small facility being built will adopt a system which permits it to abandon heavy-gravity petroleums such as asphalt.

Instead, the heavy liquids produced out of coal by the liquefying equipment itself, are to be put to use as solvents. The governmental agency and MHI will challenge the wider coal variety to be used in this facility. About 30 kinds of coal have already been collected from coal fields world wide, to select the several suited to liquefaction. Since January four different coals, from China and from Australia have been tested.

Knitting together extensive projects, and maximizing efforts for technical development, the Mitsubishi group proceeds steadily with its liquefaction undertaking.

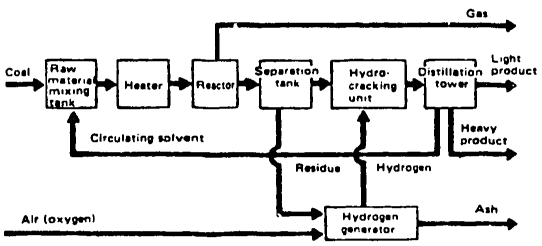


Fig. 1. Mitsubishi Group's Soluborithis Coal Liquefaction System

CSO: 4120

SCIENCE AND TECHNOLOGY

VITRIFIED HLM FOR UNDERGROUND DISPOSAL

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 58

[Text]

* The Japan Atomic Energy Commission has formulated the treatment and disposal policies of high-level radioactive wastes (HLW) discharged from a reprocessing plant, as well as a concrete future research & development project. France, the U.K., West Germany, the U.S., Japan and other nations processing such plants are studying a variety of solidification techniques by means of glass, ceramics, and metals etc; among them, a vitrification process has recently proved the most effective. With these findings, in addition to other plans including Japan's projected reprocessing plan, the basic principle has been worked out to treat and dispose of high-level wastes.

It proposes utilizing borosilicate glass for solidification, and starting construction in fiscal 1984 of a vitrification pilot plant to conduct reliability tests, in an effort to establish a glass solidification process. The volume of a solidified body is 100ℓ with a radioactivity of about 4×10^5 curies. The body may be further encased in a stainless steel cannister to prevent completely radioactive materials from leaking. Those canned wastes are to be placed for over 30 years in a strictly-protected storage facility built in the reprocessing plant site, and to be buried in a suitable geological formation after the radioactivity has decreased to a half or less. Consequently, a temporary storage technique will be developed and established along with the development though experimentation of solidification reliability. The long-term plan also shows that a possible formation for disposal will be surveyed by around 1985; the site determination in about 1995 is to be followed for about two decades by various disposing tests, thus culminating in 2015 with a demonstration burial.

CSO: 4120

SCIENCE AND TECHNOLOGY

MITSUBISHI HEAVY INDUSTRIES UNITES WITH BECHTEL IN PWR TECHNOLOGY

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 58

[Text]

* The Mitsubishi Heavy Industries (MHI) will shortly make a comprehensive technical contract will the Bechtel Power Corp. (U.S.), the world-leading plant engineering firm, in the field of PWR designing & engineering. With the introduction of Bechtel's top rank knowhow MHI will attempt to complete a PWR model, undergoing thorough safety design and quality control, to obtain an advantageous position in the domestic market, which will be in favor of BWR, contrary to the world trend. At the same time, by setting up a firm relationship with Bechtel that gives large effect on the nuclear policies of the Reagan administration, Mitsubishi speculates that it will enhance a nuclear business strategy in political decision-making. It hopes that this will favorably influence the possible reactor export, as well as the nuclear fuel cycle etc. involving uranium enrichment and spent fuel reprocessing.

MHI had been sporadically asking for Bechtel's guidance and cooperation concerning layout, piping and other major components in designing and engineering. This time however MHI will go hand in hand with Bechtel which will regularly provide full design and engineering expertise. More concretely, Bechtel's accumulated technical information, such as reactor hazard prevention, aseismic designing, core design techniques for optimum structure, and construction work management will be accessible at all times; in addition, Bechtel is to assign engineering experts specialized in Mitsubishi's design tasks.

CSO: 4120

SCIENCE AND TECHNOLOGY

RADIATION TREATMENT OF KP-RICH DRAIN

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 59

[Text]

Studies to conserve the environment are under way in some nations on the treatment of waste by means of a radiation process, one example of the peaceful use of nuclear enegy.

The Government Industrial Research Institute, Nagoya, has taken thick waste water, such as alkali and chlorine discharge without dilution, a kind of kraft pulp (KP) drain that is hard to treat with only conventional active sludge processes or coagulation treatment, and investigated the effects of the utilization of the irradiation process when combined with other processes. Both samples are composed of malodorous waste water in which organic matters dissolve or suspend in the form of hydrophilic sol. Using the institute's cobalt-60 irradiation equipment, the samples were subjected to 5×10^6 R, and then coagulating agents such as aluminum sulfate and calcium hydroxide were added. Decomposition by oxidation of polluted materials is considered to be due mainly to O_2^- generated by radiation under the oxygen in the atmosphere. Irradiated specimens showed good sedimentation ability with more removal ability than those formed by the coagulation process. This is probably because radiation to organic substances is facilitated by the formation of organocalcium compounds.

From test findings, the results of alkali waste are tabulated; chlorine waste showed nearly the same figures. These indicate that the combined effects of radiation and coagulation correspond to the results from a triple-stage treatment: activated sludge – coagulation – absorption. Moreover, as a process which might serve as a partner for irradiation treatment, it is suggested that coagulation would be more effective than the often-referred-to activated sludge method.

Table 1. Irradiation Effects of KP Drain

	COD (ppm)	Removal rate (%)	BOD (ppm)	Removal rate (%)	Chromaticity (–)	Removal rate (%)
Untreated	1060		505		11200	
Irradiated	436	58.9	261	48.3	1180	89.5
Coagulated	287	72.9	344	31.8	3570	68.1
Combined	28	97.4	54	89.3	90	99.2

CSO: 4120

SCIENCE AND TECHNOLOGY

VOID SWELLING OF AUSTENITIC ALLOYS FOR FBR

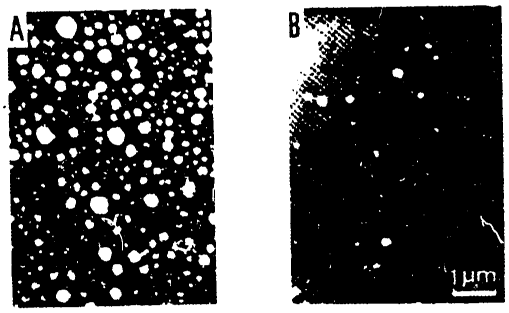
Tokyo TECHNOCRAT in English Vol. 14, No 8 Mar 81 p 59

[Text]

Fast breeder reactors that allow the efficient use of uranium fuels are now being studied and developed for realization in various parts of the world. In fast breeders, high-energy neutrons cause numerous types of radiation damage within the fuel cladding and the wrapper tubes. One of the most harmful of these is void swelling. With a view to reliability and safety during operation, the development of materials with minimized swelling is necessary.

A short-term simulation experiment by ion bombardment is being widely employed for developing materials. The National Research Institute of Metals is utilizing proton irradiation with a Peletron-type accelerator to conduct void swelling simulation for varying alloys, in the search for even more swelling-resistant metals.

The present candidates for fuel clads or wrapper tubing are austenitic alloys. To make a start, the Institute surveyed the irradiation exposure dependency of the basic Fe-Ni-Cr alloys after void swelling. The photos taken with a transmission-type electron microscope showed voids of both Fe-25Ni-15Cr alloy and Fe-45Ni-15Cr alloy under the same irradiation conditions (600°C, 15 dpa). The latter, nickel-rich, alloy clearly has voids far smaller in size and particularly in number, than the former alloy. This indicates that the more the nickel amount, the harder the voids formed. The plotted figure represents the irradiation exposure dependence of both alloys and 316 steel on void swelling at an irradiation temperature of 600°C. In this graph, Fe-45Ni-15Cr alloy undoubtedly needs more radiation exposure to initiate swelling, and has a smaller swelling increase rate than that of Fe-25Ni-15Cr alloy. Moreover, the reason why 316 steel with about 12% less Ni content resulted in low swelling mass is attributable to the other alloying elements that are considered to control swelling.



Voids (Transmission-Type Electron Microscope)

Irradiation conditions: 600°C, 15dpa
A: Fe-25Ni-15Cr alloy (swelling mass: 43.9%)
B: Fe-45Ni-15Cr alloy (swelling mass: 0.9%)

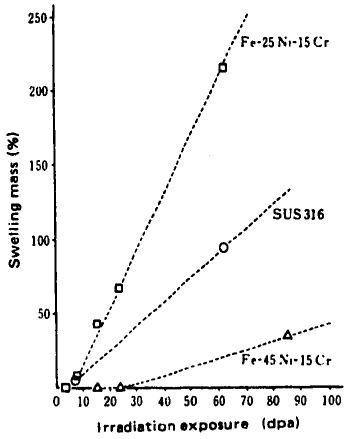


Fig. 1. Void Swelling Dependence of Various Austenitic Stainless Steels on Irradiation Exposure at 600°C

CSO: 4120

SCIENCE AND TECHNOLOGY

HIGH TEMPERATURE OXIDATION RESISTANCE OF AUSTENITIC STAINLESS STEELS WITH HIGH SILICON CONTENT

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 60

[Text]

* As high-temperature oxidation resistance of a 19Cr-13Ni-3.5Si steel is usually inferior to that of SUS 310S steel, yttrium, rare earth metals and other active metals are often added to steels to improve oxidation resistance.

The authors have experienced that some 19Cr-13Ni-3.5Si steels show excellent resistance to high-temperature oxidation. Therefore, the high-temperature oxidation behaviors of 19Cr-13Ni-3.5Si steels containing 0.0001 to 0.012% sulfur have been investigated by means of isothermal and cyclic heating at temperatures up to 1200°C. It has been found that sulfur prevent as an impurity in steels shows very harmful influence on high-temperature oxidation resistance of 19Cr-13Ni-3.5Si steels. Steels containing extremely low sulfur less than 0.001% show greater resistance to high-temperature oxidation than SUS 310S steels, and moreover, the addition of calcium to steels containing sulfur less than 0.001% is beneficial. It has also been found that nonmetallic compounds containing sulfur consisting of Ca-Al-Mg-O-S are present in steels with a sulfur content less than 0.001%, and transform into MnS on increasing the sulfur content. It is suggested that MnS compounds have a harmful influence on high-temperature oxidation resistance of 19Cr-13Ni-3.5Si steels.

In addition, the high-temperature oxidation behavior of 19Cr-13Ni-3.5Si steels containing various amounts of sulfur was clarified.

[H. Fujikawa, et al.: *Tetsu-To-Hagane*, 67 (1981) 159]

CSO: 4120

SCIENCE AND TECHNOLOGY

SIMULATION OF HORIZONTAL 2-STAND ROLLING BY PLASTICINE

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 60

[Text]

* Simulation of horizontal 2-stand rolling by plasticine, for compressive rolling and tensile rolling, has been carried out. The following items are clarified:

(i) Deformation of side face, upper face and transverse section of workpiece and distribution of principal strain rate and slippage velocity against rolls.

(ii) Force and torque acting on rolls and rolling energy.

(iii) Distribution of pressure, circumferential frictional stress and axial frictional stress acting on the roll surfaces.

(iv) Distribution of internal stress in the workpiece.

Then, the above experimental results were analyzed, and the following facts were revealed:

(i) All stress measurements could be made with sufficient accuracy.

(ii) Distribution of principal strain rate and others items coincide well with measured stress distributions.

(iii) Compressive rolling is effective to eliminate the tensile stress near the workpiece's surface. Tensile rolling slightly reduces rolling energy.

[K.Chijiiwa,et al.: *Tetsu-To-Hagane*, 67 (1981), 123]

CSO: 4120

SCIENCE AND TECHNOLOGY

A NEW IRON MANUFACTURING PROCESS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 61

[Text]

The blast furnace – convertor process, which is now the leading iron manufacturing process, requires a huge amount of equipment investment and auxieties have arisen about its future because of such factors as the shortage of material coal. In place of it, the direct iron making process has been readopted and is being reviewed in various fields. However, it is problematic in that its productivity is low as compared with the blast furnace, in that it is high in its original unit of energy and in that it is difficult for it to dispose of vein stones contained in iron ore. Accordingly it has become desirable to establish a new iron making process suited to a new era.

The National Research Institute for Metals of the Science and Technology Agency is promoting the development of a new consolidated continuous resolution reduction process which is based on the direct reduction process and which consists of a preheating reserve reduction furnace, a continuous resolution reduction furnace and a steel making furnace.

Reduced iron pellets produced by the direct iron making process are conventionally resolved by an electric furance to make steel. However, their resolving behavior is not clear in many respects. Basic research has been conducted on the effects of various factors such as the temperature of molten iron, the carbon volume, non-reduced iron and vein stones in the pellets, and slag on molten iron, all of which affect the speed of reduced iron pellets' resolution into molten iron. The research is designed to obtain the optimum conditions for resolution of reduced iron pellets. The knowledge has also been gained which is required to determine the constitution of the process, design of each furnace, operating conditions, etc. A small type continuous resolution reduction furnace, single phase 300kVA and holding 60 to 180kg of molten metal was made on a trial basis, and operational tests were conducted to grasp operational know-how and to review scale-up factors.

The relation between a pellet for each test and the original value of electric power is shown in Fig.1, where the maximum resolving capacity of high reduction-rate pellets (such as free pellets) is 6.5 to 7.0kg/min and the original value of the electric powr is 0.5kwh/kg pellet. Although it was considered that dust pellets including nearly 20% impurities consumed electricty for the production of slag, so that foamed slag would affect the furnace conditions, it has been shown that their resolution is possible with about the same efficiency as that of high reduction-rate pellets.

Fig.2 shows the relation between the inlet velocity of oxygen of iron oxide which pellets bring in, and the original unit of electric power. There is a tendency that the more the inlet velocity of oxygen increases in the case of false and dust pellets, the slower the reduction of the original unit of electric power. The limit for Fe_2O_3 is within the range of 1.0 to 1.3kg Fe_2O_3/min.

The relation between the electric power efficiency and the inlet velocity of oxygen is shown in Fig.3, where the more the inlet velocity of oxygen increases, the better the electric power efficiency becomes. This will be due to the fact that the vigorous reaction of reduction (CO boil) strengthens the churning of molten metal, assuring sufficient-transmission of heat from an arc to molten metal. Further, heat charge indicates that more oxygen can be brought in the form of iron oxide, making it possible to operate with the use of pellets of a lower metallic ratio or with an increased volume of supplied pellets.

Here results are playing an important role in the determination of the operational conditions of a scale-up plant of 1500kVA with a molten metal volume of about 1.5t. At present it is operated for quantitative proof tests to accumulate data.

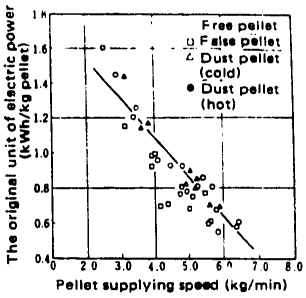


Fig. 1. Relation between Pellet Supplying Speed and the Original Unit of Electric Power

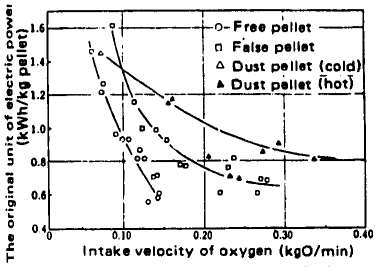


Fig. 2. Relation between the Inlet Velocity of Oxygen from Iron Oxide and the Original Unit of Electric Power

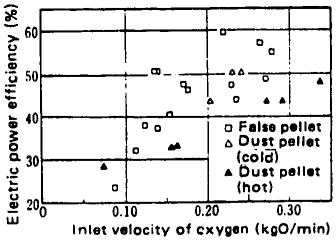


Fig. 3. Relation between the Inlet Velocity Velocity of Oxygen from Iron Oxide and the Electric Power Efficiency

CSO: 4120

SCIENCE AND TECHNOLOGY

A STEP FORWARD TOWARDS ATOMICALLY POWERED IRON MANUFACTURE

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 61

[Text]

The Atomic Power Iron Manufacturing Technology Research Association, which has been tackling the development of atomically powered iron manufacturing technology, has decided to discontinue for a while research activities, just before a test plant is built, even though favorable technical prospects have been obtained. The main reason is that the development of a high temperature gas furnace (nuclear reactor), which is the heat source for iron manufacture, comes later than scheduled.

The principle of atomically powered iron manufacture is to utilize the thermal energy of high temperature gas furnaces to produce from asphalt etc., reduced gas consisting mainly of hydrogen and carbon monoxide by which iron core is reduced, to produce iron.

This high temperature gas furnace is a nuclear reactor in which the core is cooled with helium gas and nuclear thermal energy and is taken out in the form of high temperature gas of 1,000 degrees at the maximum. It is characterized by its having a far better thermal efficiency than light-water and heavy-water reactors.

The association considers that the erection of a proof furnace will be postponed until after 1995 and it intends to apply related development technology to other fields than iron manufacture.

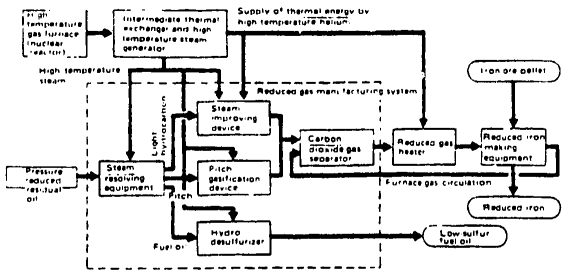


Fig. 1. Atomically Powered Iron Manufacture System

CSO: 4120

SCIENCE AND TECHNOLOGY

EFFECT OF COOLING RATE ON MORPHOLOGY OF LATH MARTENSITE IN FE-NI ALLOYS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 62

[Text]

* The effect the rate of cooling on the morphology of lath martensite in 18%Ni maraging steel, Fe-18%Ni and Fe-24%Ni alloys, was investigated in detail. The alloys were cooled from their austenite states at several different rates using iced brine, water, oil, air or using furnace cooling. The main results obtained are as follows:

(1) The sizes of packets and blocks in lath martensite structure are changed markedly with different cooling rates. The packet size and block width decrease with increase of cooling rate. This tendency was observed in all three alloys examined.

(2) Variations in M_S, M_f and the martensite-temperature curve of lath martensite in Fe-24%Ni alloy with cooling rate are hardly noticeable.

(3) Observations of the formation process of lath martensite structure with the Greninger-Troiano heat treatment indicated that the block regions correspond to the banded region clustered with parallel laths, and the packet regions are formed by the growth and coalescence of parallel banded regions.

(4) As the cause of the morphology change of lath martensites, it is concluded that the number of banded regions with parallel laths increase with increased cooling rate, and hence the final block width and packet size becomes smaller.

[K. Tsuzaki, et al.:
45 (1981), 126]

CSO: 4120

SCIENCE AND TECHNOLOGY

INFLUENCE OF HIGH HYDROSTATIC PRESSURE ON RECRYSTALLIZATION OF COPPER, AGING OF CU-BE ALLOY

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 62

[Text]

* In order to study the influence of hydrostatic pressure on the processes of recrystallization and aging of metallic materials, isothermal heat treatments have been done on cold rolled OFHC copper and Cu-Be alloy under 0.1MPa and 800MPa, and change in hardness with the holding time has been discussed. The results obtained are as follows:

(1) No evident qualitative difference in structure due to pressure was observed in the OFHC copper after the primary recrystallization.
(2) The change in hardness during the primary recrystallization was delayed by applying high hydrostatic pressure, and the time necessary for obtaining a given value of hardness under 800MPa was about 2.9 times as large as the time under 0.1MPa. This value is close to 2.5, calculated by assuming that the activation volume of self-diffusion of copper is about $0.7\overline{V}$ ($\overline{V}$ is the molar volume of copper).
(3) As for Cu-Be alloy, an increase in hardness was also delayed under high hydrostatic pressure. The time required for coming up to a certain hardness number under 800MPa was about 2 times larger than the time under 0.1MPa. Also in this case, a similar value of about 2.2 was calculated by assuming that the activation volume of diffusion of Be atom in copper is $0.55\overline{V}_{Cu}+0.15\overline{V}_{Be}$ ($\overline{V}_{Cu}$ and $\overline{V}_{Be}$ are the molar volumes of copper and beryllium, respectively).
[M. Ohtaguchi, et al.:
45 (1981), 142]

CSO: 4120

SCIENCE AND TECHNOLOGY

REACTION BETWEEN MOLYBDENUM, VARIOUS NITRIDES

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 62

[Text]

* Diffusion couples of molybdenum with several nitrides, i.e. AlN, BN, Si_3N_4, TiN, respectively, were heated in a vacuum for up to 36×10^4s at various temperatures ranging from 1573 to 2173K. The couples were then examined for composition, growth rate, structure, and hardness of reaction layers, especially for the Mo-BN couple.

Main results obtained are as follows:

(1) In the Mo-AlN system, AlN was sublimated at 1823K and did not react with Mo.

(2) In the Mo-Si_3N_4 system, Si_3N_4 decomposed at 1773K, and Si diffused into Mo and formed three kinds of molybdenum silicides at the surface. The microstructure near the interface between Mo_3Si and Mo was observed by transmission electron microscopy.

(3) In the Mo-TiN system, TiN decomposed at 1770K and Ti diffused into the surface of Mo forming the Mo-Ti solid solution.

(4) In the Mo-BN system, two sublayers of Mo_2B and MoB, identified by X-ray measurement, were formed in the surface of Mo at all experimental temperatures. The layer thickness of the former compound is greater than that of the latter. Apparent activation energy for the growth of overall layer was estimated to be 377kJ/mol. The hardness of the layer was measured and the microstructure near the interface between Mo_2B and Mo was observed by transmission electron microscopy.

[S. Morozumi, et al.:
45 (1981), 184]

CSO: 4120

SCIENCE AND TECHNOLOGY

HIGH-PURITY ALUMINA POWDER TECHNOLOGY

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 63

[Text]

The Research Development Corporation of Japan has selected 2 themes: "technology for manufacturing high-purity easy-to sinter alumina powder" and "a high-efficiency heat utilization hot-water supply system using heat pumps and boilers together" as subjects for development to be commissioned to industries, with a view to their eventual industrialization.

High-purity powdered alumina is finding increasingly wider application as a raw material for ceramics used in electrical, electronic and mechanical parts. Of all powdered alumina systems, the material for light-permeable alumina ceramics is required to be extremely pure and is all being imported at present.

The new technology for manufacturing high-purity and easy-to-sinter powdered alumina is for producing high-purity (99.9%)-comparable to light-permeable alumina materials-powdered alumina which is easy to sinter at lower temperature (by about 200°C) than required by conventional methods.

Differing from the conventional method of pyrolyzing and sintering aluminum alum, the new method uses aluminum carbonate as a base material. It allows an ammonium bicarbonate solution to react with an ammonium alum solution which is gradually added, in order to obtain a crystalized aluminum compound (AACH=ammonium aluminum carbonate hydroxide). The product is filtered, dried and then burned. This causes the stock to be pyrolyzed at around 230°C and after the emission of gaseous ammonia, turns it into γ-alumina and carbon dioxide. This γ-alumina is further heated at around 1200°C, and turns into finaly powdered alumina (mean grain diameter: 0.3- 0.4μ).

The high-efficiency heat utilization hot-water supply system using heat pumps and boilers together, on the other hand, can utilize heat highly efficiently. It collects heat and power (rotational power) form hot steam, picks up, by using the power obtained, heat from low-temperature sources such as the atmosphere, which conventionally was difficult, and supplies hot water at a temperature around 70-80°C. This is done by combining the heat thus obtained and the heat from the steam. It consists of a "simultaneous heat supply steam cycle" which utilizes thermal energy of hot steam and a "heat pump cycle" which represents a refrigerating process in reverse (see Fig. 1).

When completed, the system will largely save energy when compared with special-purpose boiler systems, because it provides high efficiency in heat utilization by utilizing low-temperature heat sources efficiently.

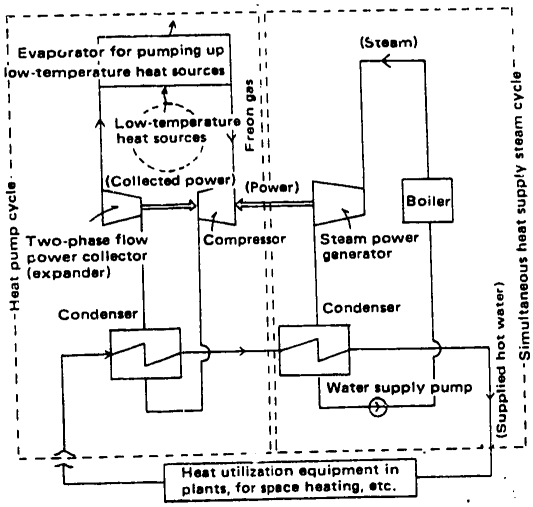


Fig. 1. Heat Pump-Boiler System

CSO: 4120

SCIENCE AND TECHNOLOGY

EQUIPMENT THAT BY USING STEAM AS A HEAT SOURCE CAN RECOVER ORGANIC SOLVENTS IN WASTE CLEANING OILS FOR RECYCLING

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 64

[Text]

* In response to increasing inquiries from large-scale users of cleaning oils for its standard type waste cleaning oil recycling equipment "IZUMI. S Series", which comes in 3 types, ranging from 18 to 54 liters per batch in processing and recycling capacity, that can recover efficiently organic solvents such as thinner and acetone contained in waste cleaning oils for recycling, Daiko Sangyo Co. has begun to accept orders, in addition to those for the above three types of equipment already on the market, for special large-size equipment, built to order, with a maximum capacity of up to 500 liters.

The IZUMI. S Series equipment is for recovering organic solvents contained in waste cleaning oils or waste de-oiled anticorrosive oils that arise in the processes of painting metals or wooden furniture, or wires from the distillation of FRP moldings, and is also for recycling them for use as cleaning solvents. Impurities dissolved in waste oils, on the other hand, come out as solids or in easily disposable forms, and so with the equipment, disposal of waste cleaning oils can be carried out safely.

SCIENCE AND TECHNOLOGY

PROCESSING TECHNIQUE FOR PUNCHING HOLES IN METALLIC SHEETS (50μ THICK) BY PRESS

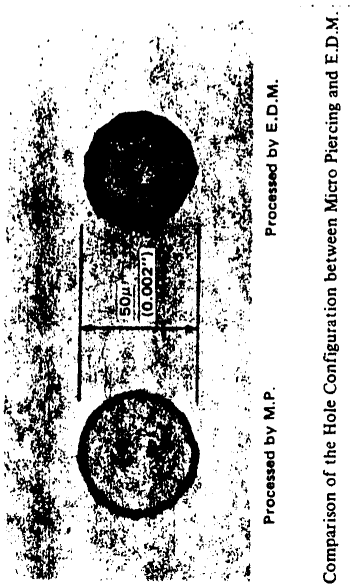
Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 65

[Text]

Nikkoshi Co. has completed the development of a technology for punching holes 40μm in diameter in metallic sheets of stainless steel, nickel alloy iron, copper etc., by press, a process previously considered very difficult.

Punching a hole in a metallic sheet, where the diameter of the hole is smaller than the thickness of the sheet, has until now been considered a hardly-to-be-realized dream because of problems such as metallic mold, but the firm has made it possible by improving the designs of the punch and the metallic mold. The firm has also developed its own press, exclusively for this purpose. Work precision is maintained within an error of ±5μm in hole tolerance, straightness and pitch. The minimum distance between holes is above 200μm (two to three times the plate thickness).

The firm has further established a high-precision bonding technique in which by using newly-developed special tools, the tolerance of punched-out sheets laminated together and used in an assembly can be maintained with a precision of 0.5%. This technique is essentially a nickel brazing, but by maintaining an accurate control of brazing material, surface joining of thin sheets of several ten microns, up to 20 sheets maximum, is obtainable.



Comparison of the Hole Configuration between Micro Piercing and E.D.M.

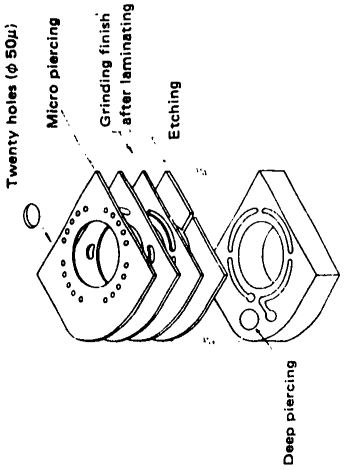
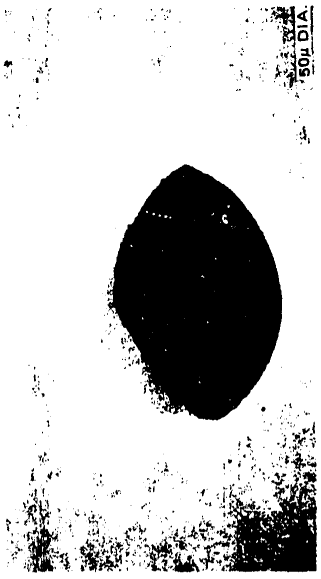


Fig. 2. An Example of High-Precision Bonding



Micro Hole Observed by the Scanning Electron Miscoscope

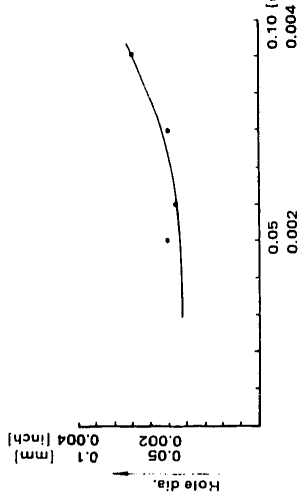


Fig. 1. Relation between the Material Thickness and Piercing Diameter

CSO: 4120

SCIENCE AND TECHNOLOGY

15-YEAR DISPUTE OVER PATENT FOR SYNTHETIC DIAMOND MANUFACTURING PROCESS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 65

[Text]

In a legal battle over the patent for a synthetic diamond manufacturing process, pitting Ishizuka Laboratory against General Electric (GE) of the U.S., a Tokyo High Court declared Ishizuka the winner last October.

Ishizuka Laboratory established its own synthetic diamond manufacturing technology in the latter half of 1950s, and started a full-fledged production of man-made diamonds by establishing in 1963 a joint venture with Komatsu Ltd., Komatsu Diamond Industry. The patent dispute between the two parties began in 1964 when GE filed a suit against Ishizuka for violation of patent rights and applied for a provisional injunction.

A synthetic diamond is manufactured by heating carbon in a temperature exceeding 1000°C and applying a high pressure of 50,000–60,000 atmospheric pressures. The hardest part of the technology is how to prevent the cylinder from becoming damaged when applying pressure on the carbon by piston, and the differences between the two sides focused on that point.

Under the GE process, the interior wall of the cylinder is built at an inclination, to impart some of the piston pressure to the cylinder itself through a gasket. In this way, the cylinder is protected from damage by controlling the direction of the pressure.

With the Ishizuka method, a cylinder made of a super-hard alloy has another cylinder of alumina ceramic installed inside. The inside ceramic cylinder attenuates the pressure from the piston and mitigates the pressure bearing on the outside cylinder (made of a super-hard alloy) protecting it from damage.

By confirming and acknowledging the pressure-reducing effect of the ceramic cylinder of the Ishizuka Laboratory process, the Tokyo High Court upheld the lower court decision and rejected the GE appeal.

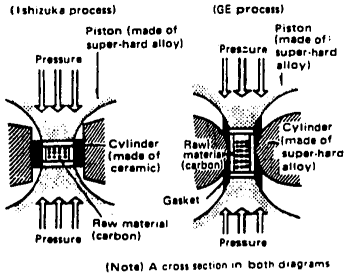


Fig. 1. Schematic Diagrams of Ishizuka Laboratory and GE Manufacturing Processes

CSO: 4120

SCIENCE AND TECHNOLOGY

MANUFACTURING TECHNIQUES FOR AIRCRAFT, SPACE INDUSTRIES

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 66

[Text]

• The Association of Mechanical Technology has completed its investigative survey of manufacturing techniques for aircraft and space industries, which promise to be two of the major industries in the 1980s.

The report of the investigation consists of 3 sections, as follows:

(1) The present conditions and necessary advances in the near future of manufacturing techniques for the engines and bodies of aircraft in Japan.

(2) The possibility of realization of production techniques from the view-point of Japanese machine tools makers.

(3) The trend in the aircraft industry and the manufacturing techniques of aircraft Jet engines in the U.S.

According to the report, the present conditions and the points at issue for the manufacturing techniques in respect to machine tools are as follows:

For aircraft body production techniques there are the following 4 problems:

a. shortening of developing time,
b. lighter weight of parts,
c. better quality of parts,
d. improvement of productivity.

In order to settle these 4 points, machine tool makers have to set themselves 11 problems: numerical controllization of various machine tools, improvement of dynamic stiffnesses and rated machining capacity for multi-axis NC machine tools, advanced adaptive control techniques, development of soft-wares for CNC and DNC, programming automations, long-time unmanned operation and reliability improvement, workpiece defense at machine tool failure, easier maintenance and quicker recovery, better operationability, improvement of inter-faces such as tool holders and cutting chip treatment.

For engine machining, the following problems are pointed out: treatment of difficult-to-cut, form and joint materials, machining of complex three dimensional, and thin wall workpieces.

In order to settle these problems, machine tools have to establish a stiffer structure and a higher degree of accuracy.

CSO: 4120

SCIENCE AND TECHNOLOGY

SUPER PRECISION LATHE

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 66

[Text]

* Toshiba Machine Co. and Toshiba Corp. have jointly developed a super precision lathe in which are installed super precision air bearings. The new lathes are manufactured by Riken Seiko Co., which is an allied company of the Toshiba Machine Co.

The main spindle of the lathe is supported by air bearings and the machine has a super machining accuracy of 0.02μm in flatness, and may be used with diamond tools for the machining of glass-fiber connectors for an optical transmission and a laser mirror.

The company has mainly manufactured large size machine tools but it is now embarking upon the super precision lathe field as a chain of higher, value added, machine development. The air bearings in the lathe were developed by the company in alliance with Tokyo Shibaura Electric Co., and the company has succeeded in practical manufacturing of them.

Applying the airbearings, the main spindle generates no heat even at the high speed of 20,000rpm., consequently the machine has no thermal deformations and can achieve super precision machining. Then, the lathe may also be used for the machining of super precision parts of a sub-micro-meter, such as disc plates of VTRs, plastic lenses and laser mirrors. The Riken Seiko Co., which manufactures the lathes, is one of the allied companies of the company and it has manufactured small machining centers, lathes and milling machines.

The Riken Seiko Co. will manufacture the super precision lathe one set/month, with the technical license of Toshiba Machine Co.

CSO: 4120

SCIENCE AND TECHNOLOGY

EXPORT OF SINTERED CARBIDE TOOLS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 66

[Text]

* Sumitomo Electric Industries, Ltd. has established an overseas sales company in West Germany to expand its exports to European Countries.

The company's new Hokkaido plant has started full scale operation, and the company plans that (1) the business results will have reached ¥30,000 million by 1985, (2) the export ratio will, until 1988, be increased from 10% (now) to 50%, and a half of the exported products will be manufactured in overseas plants.

The company has already established in the U.S. Sumiden Curbide America, a sales company, and it is now selling products of $200,000 per month, and has a plan for actual production when business reaches $500,000.

The market scale of Europe is ¥10,000 million, a half of the U.S., and the majority of shares are accounted for by Sund Bick (Sweden), Kena Metal (U.S.) and G.E. Carboloy (U.S.). Japanese makers have few shares in Europe now. The company has exported products of $200,000-250,000, via its Besci agent. Establishing the new sales company in West Germany, the company marks export increases of two times, including Sumiboron (CBN tools) and Sumidia (sintered diamond tools) as its startegic products.

CSO: 4120

SCIENCE AND TECHNOLOGY

CONTRIBUTION TO COMPOSITE POSITIONAL TOLERANCING

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 67

[Text]

1. Introduction

In discussing tolerancing showing in technical drawings, one of the most important problems is composite positional tolerancing. In this paper two methods of combined positional tolerancing, including composite positional tolerancing, are compared from the viewpoints of tooling and vertification techniques, and further, statistical considerations of the problem are reported.

2. Comparison of Two Methods of Combined Positional Tolerancing

Fig.1 shows an example of composite positional tolerancing in order to simplify considerations, application of the maximum material principle is not taken into account. According to ANSI-Y14.5 the tolerance zone for hole axes in the case of Fig.1 is as shown in Fig.2, On the other hand, an example of a combination of positional and coordinate tolerancing is shown in Fig.3, and Fig.4 shows the tolerance zone in this case. In the case of Fig.2, the hole axes must lie concurrently within both tolerance zones of the circles of diameter T_1, and diameter T_2. In the case of Fig.4, it is only required that the center of circles of diameter T_1 lie within the square of side length T_2'. The above concepts are due to ANSI-Y14.5. In ISO/TC10/SC5, it is discussed that there is a contradiction between the concepts illustrated in Fig.2 and Fig.4.

3. From the Viewpoint of Tooling

Let us suppose that the part, shown in Fig.1 is set on a machine tool by using datums A and B as setting bases, and that drilling of holes is carried out. In Fig.5, the broken lines show the machine's x- and y-axes. Positioning accuracy of the machine tool is expressed by the circle with diameter t. Diameter T_1 in Figs.2 and 4 depends mainly on the above positioning accuracy of the machine, and diameter T_2 in Fig.2 or the side length T_2' in Fig.4 depends mainly on the accuracy of positioning the part on the machine tool.

4. From the Viewpoint of Verification

Let us suppose that datums A and B of the part are made coincident with the x- and y-axes of a coordinate measuring instrument, and that the coordinates of the hole axes are measured. The coordinates of the base points corresponding to the actual hole axes $P_1 \sim P_4$ in Fig.6 are shown in Table 1. The primary base points correspond to the centres of circle T_2 in Fig.2 or square T_2' in Fig.4, and the secondary base points to centres of circle T_1 in Fig.2 or Fig.4.

The values of parameters ξ, η and θ which determine the secondary base points, are obtained using the least squares method as follows: firstly, the sum of squares of deviations SS is expressed by the following equation:

$$SS = \Sigma \left\{ (\Delta x_i - \xi_i)^2 + (\Delta y_i - \eta_i)^2 \right\} \quad (1)$$

where

$$\Delta x_i = x_i - a_i \,, \quad \Delta y_i = y_i - b_i \,. \quad (2)$$

The estimates for ξ, η and θ can be obtained to minimize the value of SS as follows:

$$\hat{\xi} = \Sigma \Delta x_i / 4 \,, \quad \hat{\eta} = \Sigma \Delta y_i / 4 \,,$$

$$\hat{\theta} = \left\{ b\,(\Delta x_1 + \Delta x_2 - \Delta x_3 - \Delta x_4) - a(\Delta y_1 - \Delta y_2 - \Delta y_3 + \Delta y_4) \right\} / \left\{ 4\,(a^2 + b^2) \right\} \quad (3)$$

For the case Fig.2,

$$\max(\delta_i) \leqq T_1/2, \max(\Delta_i) \leqq T_2/2 \quad (4)$$

where

$$\delta_i = \sqrt{(\delta x_i)^2 + (\delta y_i)^2} \,, \quad \Delta_i = \sqrt{(\Delta x_i)^2 + (\Delta y_i)^2} \,,$$

$$\delta x_i = \Delta x_i - \hat{\xi}_i, \quad \delta y_i = \Delta y_i - \hat{\eta}_i \,. \quad (5)$$

For the case Fig.4,

$$\max(\xi_i) \leqq T_1/2, \max(|\hat{\xi}_i|, |\hat{\eta}_i|) \leqq T_2'/2 \quad (6)$$

where the values of $\hat{\xi}_i$ and $\hat{\eta}_i$ are obtained by substituting the values of Eq. (3) into ξ_i and η_i of Table 1.

5. Statistical Considerations

From the viewpoint of tooling, Δx_i and Δy_i are given by the following equation:

$$\Delta x_i = \delta x_i + \xi_i \,.\; \Delta y_i = \Delta y_i + \eta_i \qquad (7)$$

where ξ_i and η_i are give.. in the "secondary base points" column in Table 1.

Assuming that the distributions of δx_i and δy_i are both $N(0, \sigma_1^2)$ and that they are independent of each other, the distribution of δ_i is Rayleigh type, and the probability density is as follows[2]:

$$f(\delta) = (\delta/\sigma_1^2) \exp\left\{-\delta^2/(2\delta_1^2)\right\} \qquad (8)$$

Assuming that the distributions of ξ, η and θ are $N(0, \sigma_2^2)$ $N(0, \sigma\theta^2)$, and that they are mutually independent, the distributions of ξ_i and η_i are $N(0, \sigma_2^2 + b^2\sigma\theta^2)$. If the difference between a and b is not so large, the distributions of $\sqrt{\xi_i^2 + \eta_i^2}$ and Δ_i are both Rayleigh type approximately.

From these considerations and the property of Rayleigh distribution, the composite positional tolerancing (Fig.1) is more rational than the combination of positional and coordinate tolerancing (Fig.3). For the cases of Fig.2 and Fig.4, Equations (4) and (6) are applied respectively. Therefore, the tolerance zone of Fig.2 seems to be severer than that of Fig.4, but it is found from the following discussion that the tolerance zone of Fig.2 is not so severe. Since the distributions of δ_i, $\sqrt{\xi_i^2 + \eta_i^2}$ and Δ_i are all Raleigh type, the following relation among the tolerances for them holds:

$$T_1^2 + T_2''^2 = T_2^2 \qquad (9)$$

where T_2'' represents the tolerances for $\sqrt{\xi_i^2 + \eta_i^2}$. It is found from Equation (9) that the relation between T_2''/T_2 and T_2''/T_2 is as shown in Fig.7. For example, $T_2''/T_2 = 0.97$ if $T_2/T_1 = 4$.

6. Conclusions

(1) For two types of combined positional tolerancing the verification technique using least squares method is presented.

(2) According to statistical considerations, composite positional tolerancing is more rational than the other positional tolerancing, and the tolerance zone for the former is not so severe in comparison with that for the latter.

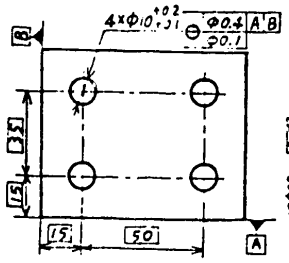


Fig. 1. An Example of Composite Positional Tolerancing

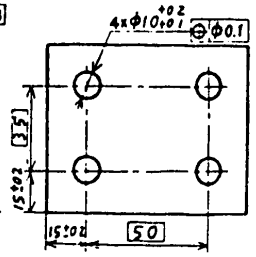


Fig. 2. Tolerance Zone for Hole Axes of Fig. 1

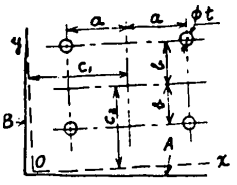


Fig. 3. An Example of a Combination of Positional and Coordinate Tolerancing

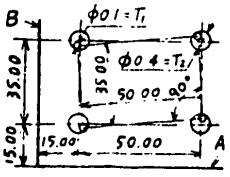


Fig. 4. Tolerance Zone for Hole Axes of Fig.3.

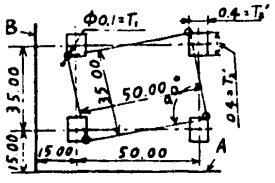


Fig. 5. Positioning of Part on Machine Tool

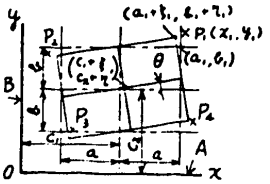


Fig. 6. Postioning of Part on Measuring Instrument

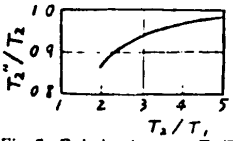


Fig. 7. Relation between T_2/T_1 and T_2'/T_2

Table 1. Coordinates of Base Points for Hole Axes

P_i (x_i, y_i)	Primary base points (a_i, b_i)	Secondary base points $(a_i + \xi_i, b_i + \eta_i)$
P_1	$c_1 + a, c_2 + b$	$a_1 + \xi - b\theta, b_1 + \eta + a\theta$
P_2	$c_1 - a, c_2 + b$	$a_2 + \xi - b\theta, b_2 + \eta - a\theta$
P_3	$c_1 - a, c_2 - b$	$a_3 + \xi + b\theta, b_3 + \eta - a\theta$
P_4	$c_1 + a, c_2 - b$	$a_4 + \xi + b\theta, b_4 + \eta + a\theta$

CSO: 4120

SCIENCE AND TECHNOLOGY

COAT TREATMENT TECHNIQUE RAISING FUEL CONSUMPTION EFFICIENCY OF ACTUAL WORKING JET ENGINE

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 68

[Text]

* Ishikawajima-Harima Heavy Industries Co. has recently succeeded in the development of a coat treatment technique which raises fuel consumption efficiency by coating the stator vanes (fixed blades) of jet engines.

It is said that an increase in the fuel efficiency of jet engines is difficult to obtain even for newly-mode engines and that an increase in the efficiency of actual working engines is ever harder; a rise of 1% being extremely difficult to attain.

The company has successfully developed a thermetal double coating technique which not only raises fuel efficiency but which is also excellent in preventing the effects of corrosion, and which works by coating stator vanes of "JT8D" carried by Boeing 727 and 737, DC9, etc. with coating powder, the main ingredient of which is aluminum. The data so far obtained shows that the efficiency has been raised 0.8% by the coating. It is considered that it will come near the goal of 1% when combined with the corrosion preventing effect. The coating effect works on the principle that a vane at the inlet port of an engine is subjected to coat treatment to smooth the surface so as to obtain a good flow of suction air, with the result that the amount of fuel used is reduced.

The company has also been conducting researches for raising efficiency by changing the shape of a compressor vane within the engine. However, the coating technique has first been put to practical use.

The amount of jet fuel consumption by All Nippon Airways and Toa Kokunai Koku, which are entrusting overhauls to the company, is said to be roughly ¥100,000 million per year. This means that energy amounting to ¥1,000 million can be saved if coating is applied to all engines, including the "JT8D".

CSO: 4120

SCIENCE AND TECHNOLOGY

TRAVELING DISTANCE INDICATOR SAVING 10 PERCENT OF FUEL COST

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 68

[Text]

* Hino Motors and Hino Motor Sales Co. have developed a computer-controlled economic travel distance indicator "ER Monitor" as a fuel saving part for trucks.

The device feeds the fuel characteristics of an engine into a micro-computer to check whether the working conditions of the engine under operation meet the traveling conditions or not. The mechanism is that a pair of red and blue indication lamps attached to the instruments panel tells a driven if he is in optimum conditions. Such an economic travel check device controlled by a computer has been used for the first time on trucks.

According to the newly developed ER (Electronic Running) monitor, the working conditions of an engine under operation are fed into a computer in which fuel characteristics are stored, and the blue indication lamp comes on when the operating conditions meet the traveling conditions and the red comes on otherwise, so that the operating conditions of the engine can be easily known. When the red indication lamp is on, shift-up or shift-down is made, or both are operated so that the blue lamp is always on. This enables fuel costs to be reduced by about 10% on usual roads.

For the time being applicable types are large-sized trucks of the company's make. In the near future, the development will be put to practical use for medium-sized trucks and buses. The price is ¥39,000 (exclusive of mounting cost).

CSO: 4120

SCIENCE AND TECHNOLOGY

LIGHT-WEIGHT STAINLESS STEEL CARS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 68

[Text]

* Tokyu Sharyo Company has completed a remarkably light-weight stainless steel car (8090 type) which reduces the amount of operational power consumption by 5%. as compared with conventional stainless-steel cars.

Railway cars are made of ordinary steel, stainless steel, and aluminum, of which stainless steel was considered to attain light-weight by the absence of coating and corrosion. However, Tokyu Sharyo Co. has used stainless steel (SUS 301 type) of high strength to successfully obtain small thickness. Thin structure is also attained through three-dimensional analysis by a large-scale computer.

As a result, a trail car of 8090 type is 23.9t per car – very light-weight when compared with 26.5t of a conventional stainless steel car and 30t of an ordinary steel car. It is equal to an aluminum car.

This permits equivalent operating characteristics to be obtained if one trail car is added to a conventional train of 4 motor cars and 2 trail cars. Electric power consumption can be reduced by 5% in express operation as compared with conventional stainless steel cars.

CSO: 4120

SCIENCE AND TECHNOLOGY

DRIVE COMPUTER DEVELOPED BY NISSAN

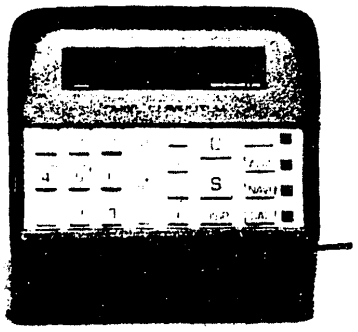
Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 69

[Text]

Nissan Motor Co. has succeeded in commercialization of an adaptable drive computer which can easily be equipped to any car.

The drive computer can be equipped in any car merely by placing a car speed sensor on the speed meter. Also, it can be placed in any location such as overhead, in the console or instrument section.

The function is as follows: (1) a trip meter which indicates the distance from the starting point with a 10m unit, indicates the distance remaining to destination determined in advance, and buzzers when the distance to the destination reaches within 0.5km; (2) an alarm which flashes and rings when a specified speed is exceeded; (3) a navimeter which indicates in seconds the gain and delay from a specified speed (4) a 6-digit calculator is built-in; (5) a memory function which stores data for 24 hours even if the ignition key is removed.



Drive Computer

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW-BUILT SHIP COMPLETED

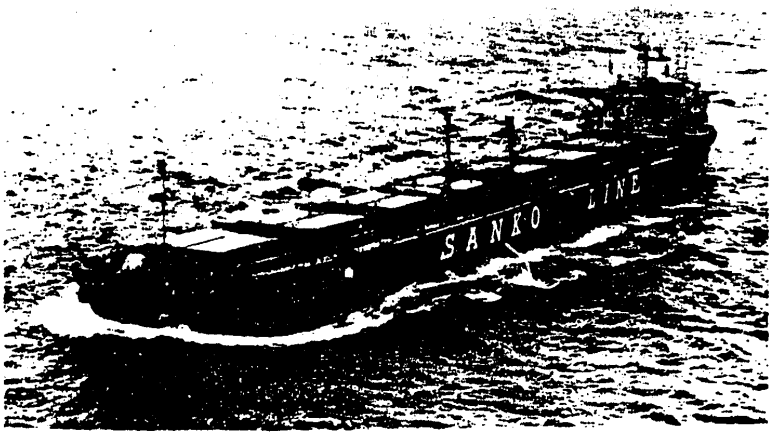
Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 69

[Text]

Kawasaki Heavy Industries has recently completed "Juko Maru", the ship designed for bulk carrying of ore and crude oil.

The main particulars of the ship are as follows:

Length (overall)	*236.0m*
Breadth	*32.2m*
Depth	*20.1m*
Main engine	*Kawasaki MAN 12V 52/55A type Diesel engine (one set)*
Maximum output	*1193 hp. x 440 r/min*
DWT	*42652t*



Juko Maru

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW TECHNIQUE FOR INTEGRATION OF GaAs

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 70

[Text]

* A new technique for integration of GaAs semiconductors has been developed by the Electrotechnical Laboratory of the Agency of Industrial Science and Technology. The GaAs semiconductor is looked at as a possible replacement for conventional silicon semiconductors.

The particular target is a positive-logic GaAs semiconductor device suitable for high-speed arithmetic devices. The key point is to use Shottky junctions at the connections between all devices needed for integration. In other words, the level shift circuit that normally consists of several diodes and a power supply is replaced by only one Shottky junction. This saves space and reduces power consumption. Based on this, an integrated circuit consisting of 11 devices was produced with 3μm line width. In experiments it exhibits high performance and has a signal delay time of only 120ps per device and power consumption of 10 to 12mW. Particularly, power consumption is about one-third that of conventional devices. The Research Institute says that if line width is reduced to 1μm, a high-speed integrated circuit with a signal delay time of less than 50ps and power consumption of only a few mW can be achieved.

CSO: 4120

SCIENCE AND TECHNOLOGY

VOICE SYNTHESIS BOARD

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 70

[Text]

* Matsushita Electric, Matsushita Technical Institute, Matsushita Communications Industries, and Matsushita Electronics, have jointly developed a voice synthesis LSI MN1261 that can freely generate various sounds with high quality, and they plan to market it as a voice synthesis board.

The MN1216 can freely synthesize various sounds, such as male and female voices, animal cries or machine-generated sounds. It has high quality characteristics and can be used in broadcasting and business applications where conventional voice synthesis systems cannot be used due to low quality.

In addition to the MN1261, the synthesis board consists of a microcomputer (MN1562) for the separate controller and ROM to store voice data. The selling price of the voice synthesis board with 64k bytes of ROM that can speak for about two minutes is approximately ¥640,000.

The principle for generating a wide variety of voices is as follows:

(1) Voice quality is enhanced by increasing the resolution of the digital filter corresponding to a human voice from 14 to 16 bits.

(2). The voiced sound source that closely corresponds to the voice vibration waveform that generates various sounds is placed in RAM from the two-voice fixed ROM. The optimum voice is then synthesized from this.

(3) The unit length for voice analysis used to be only 20 or 20ms, but now four levels of 3.5 thru 5ms are available. This produces a sound much nearer the natural sound.

(4) The decoding table for voice parameters is stored in ROM, and bit allocation can freely be made to generate clear sounds.

The basic technique is based on the PARCOR method developed by NTT.

CSO: 4120

SCIENCE AND TECHNOLOGY

SUPERCONDUCTIVE DIODE

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 70

[Text]

* The Electrotechnical Laboratory has developed a "Super Schottky Diode" (SSD) based on superconductivity phenomena. This device connects niobium, a superconductive metal, to a gallium/arsenic semiconductor. It is cooled to an absolute temperature of 4.2°, and for detecting microwaves or milliwaves, it has about 20 times the sensitivity of conventional devices. It is expected to be of great value in satellite communications, remote sensing, and radiotelescopes.

The theory for achieving higher performance by cooling the metal part of a Schottky diode to give a superconductive condition has been known for some time (for example, the use of lead as announced by the Aerospace Co.), but until now no one has produced a device with a stable life. The laboratory used the latest circuit production techniques, such as electronic beam exposure, to their fullest extent and used niobium in developing the low-noise SSD that is durable for practical use and has high sensitivity.

The device is arranged on its substrate so that the gallium/arsenic semiconductor faces the metal niobium, and the semiconductor contacts the metal at its center. This contact area is very small, 5μm vertical and 4μm horizontal. If the dimensions can be made smaller, an SSD with even higher sensitivity can be made.

CSO: 4120

SCIENCE AND TECHNOLOGY

POWER TRANSISTOR FOR SWITCHING REGULATORS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 71

[Text]

Toshiba has developed a power transistor for high-speed, dedicated, switching regulator for an 800V system. A new high pressure resistance power transistor technique, called GPL (Glass Protection Plane), is used to produce this transistor.

This GPL technique sets a glass passivation film on the surface along which the depletion layer is extended and the electric field diminished. This keeps the base depth less than 10μm in the same way as for normal high frequency transistors.

In addition to this, a polycrystal resistance called EPR structure, is put on the emitter, and the technique that enhances disruptive intensity is linked to acquire high frequency, high output, and high pressure resistance. The switching time is almost the same as that of the 400V system for rise, storage, and fall-time.

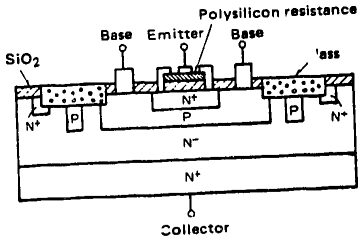


Fig. 1. GPL Transistor

CSO: 4120

SCIENCE AND TECHNOLOGY

NvN/Pb JOSEPHSON DEVICE

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 71

[Text]

The Integrated Technical Research Institute of the Agency of Industrial Science and Technology has developed an integrated technique for a highly stable Josephson device.

At present, the Pb alloy technique is used to produce Josephson integrated circuits but has some problems with stability. The use of a mechanically strong superconductor, such as a Nb or Pb compound was studied, but it was also found to have some problems. For example, it was difficult to create thin a film with good superconductivity, and to obtain good tunnel characteristics when a junction was made. In addition to these problems, it was very difficult to make the superconductor smaller and integrated because it was mechanically hard.

NbN used in this study has a high critical temperature (Tc=15°K), and it can be made into a thin film fairly easily by sputtering Nb in a mixed atmosphere of Ar and N_2. Less degradation caused by the temperature cycle which causes problems in a Pb system device, because NbN is mechanically hard. The energy gap is also large because rubbing is made by a superconductor with a high critical temperature and voltage is generated at switching time (gap voltage of the prototype is about 3.9mV), which is convenient for use in logic or memory devices.

In general, a high substrate temperature (500°C to 800°C) is required to create compound superconductive thin film. For this, a new patterning method has been developed which uses ZnO thin film as a high temperature resist.

Fig.1 shows the process.

Fig.2 shows the temperature cycle between room and low temperature (4.2°K) or variation in device characteristics to maintain room temperature.

Fig.3 is a model of a tunnel junction.

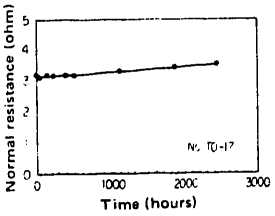


Fig. 1. Variation of Tunnel Resistance During Temperature Cycle

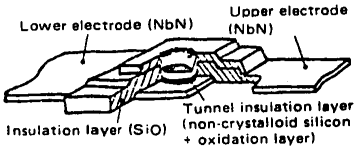


Fig. 3. Model of NbN/NbN Tunnel Junction

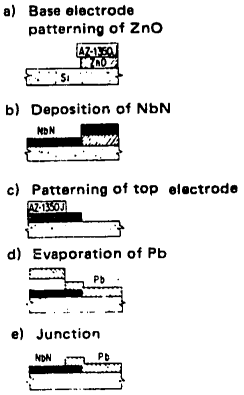


Fig. 2. Creation of NbN/Pb Josephson Device

CSO: 4120

SCIENCE AND TECHNOLOGY

BROAD-WAVELENGTH VARIABLE DYE LASER

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 71

[Text]

The Physical and Chemical Research Institute has developed a powerful broad-wavelength variable dye laser spectrosystem to observe material conditions at the atom and molecule level. This system has a 2ns time resolution power and a 0.45GHz frequency resoltuion power (spectral width is 5/1000Å) Wavelength can freely be set in the visible light area (0.4 to 8mm) and moved. The peak output is 30 to 40kW, which is rather large. This system is expected to be very useful for observing intermediate chemical reaction processes that occur quickly and for precise analysis of minute amounts of material.

The optical system configuration is as shown in the Figure. If the nitrogen laser light is focused on the cell containing the dye solution, fluorescence is emitted in various directions. If the fluorescence emitted in the horizontal direction is made stronger by stimulated emission, it will move forward and backward between the lower output mirror and the upper grating. Between them, light is amplified and is emitted as laser light via the external etalon.

The output mirror acts to return the light that enters the grating vertically. The grating and the etalon determine the wavelength by changing angles. The internal etalon consists of two high precision mirrors with a 90% reflection factor (a 10% of transmission factor) that face each other with a 2.5mm gap between them. If the incoming light here lets etalon have an internal angle during mutireflection, only the light with of a particular wavelength is overlapped and made amplified, and then it is emitted.

If the grating angle is changed by placing a slit on the reflection side of the grating, light of the desired wavelength can be emitted.

The beam magnifier consists of a combination of two pieces of a prisms. It expands the beam width, enhances directivity, and increases the capabilities of etalon and grating. The external etalon (the gap between both mirrors is 25mm which is 10 times the internal etalon) was added to the above configuration, and rhodamine 6G dye was used to check its capabilities because it was easily available. Rhodamine 6G oscillated the laser with a 5800 to 6100Å wavelength at a peak of around 6100Å. The width is 90GHz if frequency conversion is made. As a result of the experiment, the spectral width became 30GHz when operation was made only by the grating without using the internal and external etalons. If the internal etalon was inserted, the width was narrowed to about 2GHz and the addition of the external etalon achieved 0.45GHz.

Under computer control of the actual system, the optical element can be very precisely driven mechanically, and a highly pure oscillating spectrum can be freely controlled over a wide range of wavelengths.

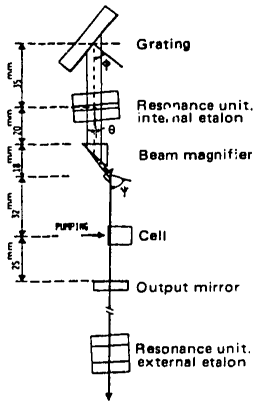


Fig. 1. Optical Configuration of Dye Laser

CSO: 4120

SCIENCE AND TECHNOLOGY

PORTABLE CONVERSATION AID DEVICE

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 72

[Text]

* The Tokyo Metropolitan Industrial Technology Center has successfully made a portable conversation aid device on experimental basis, for verbally handicapped people. The center first attempted to produce equipment for verbally handicapped people three years ago. Separate to this so far the center has developed such welfare equipment as a new type of wheel chair. The first model of the conversation aid was too large in size to be carried conveniently. Therefore the center has since been proceeding with improvements of a more practical unit, resulting in the second experimental model.

It is provided with 55 push buttons, each of which can be used two ways; enabling the equipment to display 61 Japanese characters, numbers, and symbols on an LCD panel. The second model saves power dissipation by employing a liquid crystal display not used in the first one, which used LED's (light emitting diode) to display the characters, etc. The display part, though of only 16-character capacity, can display sentences because each push of a button shifts the display to the left by one character.

It is also provided with five function keys with which to prepare programs of most-frequently-used cliches; the first key displays "I beg your pardon?", the second key "I see," the third key "Is that so?," and the fifth one "at your will".

The another feature of the second model has a telephone-use acoustic coupler provided. Verbally handicapped people can get through to each other by gestures or writing using face-to-face conversation but not in telephone conversation. However, the acoustic couplers enable them to have a talk with each other by seeing the same characters displayed on each conversation aid. The center says it will, in view of the expanding technology of a sound synthesizer device develop in future, such a device as to give sounds by a push on the key together with character displays.

CSO: 4120

SCIENCE AND TECHNOLOGY

OFFSET PARABOLIC ANTENNA

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 72

[Text]

* NTT (Nippon Telephone and Telegraph) has been proceeding with developments of an antenna having excellent wide-angle directivity, in an attempt to produce a new type of offset parabolic antenna. They have carried out trial producing and have executed on-the-spot tests. The good results of the test have led NTT to decide to introduce it as a practical antenna for use in 1981.

The high dependence of wide-angle directivity of the primary radiator's characteristics being taken into consideration, the antenna employs a coalgate horn as the primary radiator, which provides almost equal characteristics to both of horizontal and vertical polarized waves. As a result, the new type antenna gave 15 degrees of the minimum branching angle, one sixth of that presently available and thus simplifying line design. Moreover it gave as good results at 40 dB or more (30 to 36 dB is conventional) with cross polarized wave discrimination and 50 dB at 11 GHz or 52 dB at 15 GHz of antenna gain.

NTT, based on these results, has been engaging in further research and development of this type of antenna since 1980, aiming at its regular use.

CSO: 4120

SCIENCE AND TECHNOLOGY

OPTICAL-ELECTRICAL COMPOSITE CONNECTOR

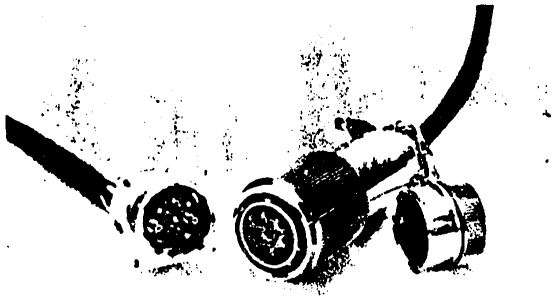
Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 73

[Text]

Japan Aviation Electronic Industry, Ltd. has developed and begun marketing a composite optical (8-core) connector made by combining optical and electrical circuits. This is a new type of connector which is available in free combinations, as required, of optical and electrical circuits (such as a combination of 2 optical circuits and 6 electrical circuits, or of 4 optical circuits and 4 electrical circuits).

This connector uses a round bayonet lock system, and is dew-proof to enable outdoor application. The electrical circuits are of a type which has a contact equivalent to AWG#12 inserted after wiring. The optical contact is for 125μm (core: 60μm) clads and the super-accuracy ferrule which has a gem as a shaft uses a grinding system which permits in-site assembly. The end bell incorporates a contact holder for preventing the optical contact from inclining, and is designed to withstand vibration.

The main specifications of the new connector are as follows: 1) rated current: 20A; 2) rated voltage: 350V DC and 250V AC; 3) optical contact: 125μm clad; 4) loss: below 1.5dB.



Optical-Electrical Composite Connector

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW ELECTRONIC POSTAL SERVICE

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 73

[Text]

The Ministry of Posts and Telecommunications intends to add new services which permit users to use their own facsimile systems in conjunction with its electronic postal services, for which the Ministry will start test services in the spring of 1981.

The electronic services of the Ministry are intended to promote modernization of its postal and telecommunication services while utilizing the existing delivery systems. Thus, the test services currently being prepared will be virtually identical to the present services, with only mail transfer services being substituted by facsimile communications services. For collection services, on the other hand, the Ministry is considering a visiting service to collect manuscripts from major users. For the time being, however, it will adopt the system which as a rule obliges users to bring their manuscripts to post offices.

The new services are intended to eliminate this incovenience. In the first step of the test services which will start around May, international standard GIII compatible high-speed facsimile systems will be installed in post offices, and users will have the option of using their own GIII facsimile systems to transmit their manuscripts directly to post offices.

The Ministry will purchase 6 high-speed facsimile systems for electronic postal services, using its fiscal 1980 budget. They will be installed in key post offices in Tokyo, Osaka and Nagoya. In fiscal 1981, the Ministry will additionally purchase their improved models to replace the originally-installed models. The first models will be reinstalled in key post offices in Fukuoka, Yokohama, and Sapporo to properly begin the first step of the test. The Ministry also intends to review new services in earnest in fiscal 1981.

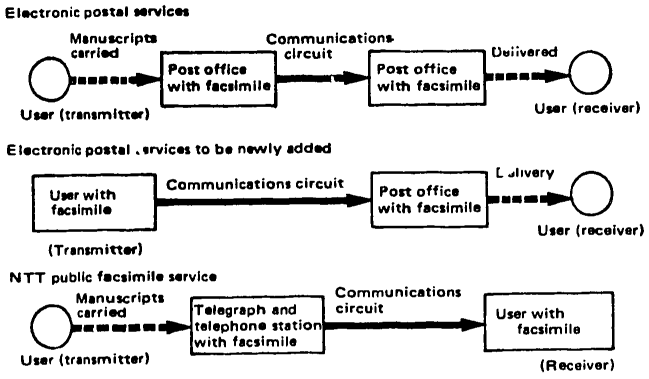


Fig. 1. New Electronic Postal Services

CSO: 4120

SCIENCE AND TECHNOLOGY

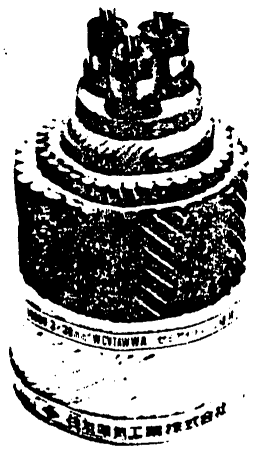
SUBMARINE CABLE HIGHLY RESISTANT TO EXTERNAL DAMAGE

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 73

[Text]

Sumitomo Electric Industries has developed a steel band-fitted double iron wiring semi-irish armored cross-linking polyethylene-insulated submarine cable, 6600V, 3x38mm², which is highly resistant to external damage. A new test cable has been installed in the Inland Sea of Seto.

Conventional damage to submarine cables has usually been caused by fishing tools and anchors. Thus, the most common method of their installation has been burying. Burying, however, is often difficult because of hard sea bottoms. The new cable is more than twice as strong as conventional types, and can be handled in the conventional manner.



Semi-Irish Armored Cross-Linking Submarine

CSO: 4120

SCIENCE AND TECHNOLOGY

COMPUTERS USED IN 1979

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 74

[Text]

• The Japan Information Processing Development Center has compiled a "Computer usage survey, 1979" based on 1271 computer companies. The survey shows (1) investment in computers has a slightly decreasing tendency and (2) the computer monthly expense per employee has remained unchanged at ¥16,800 of overall industry average, the same as that of 1978. The essential points of the survey are as follows:

1. Computer investments; For three years beginning from four years ago, the "estimated computer investment scale 5 years hence" averaged 1.9 times, while it even decreased to 1.8 times.
2. Input systems; The tendency has become clear that sharing punch-card input type computers has decreased, while that of key-in-type or OCR-type computers has increased.
3. Computer expense vs. monthly turnover ratio: The overall industry average became 3.66/1000, an increase a little over that of the previous year (3.00/1000) due to an increase in the number of the companies which have adopted on-line systems.
4. Computer monthly expenses per employee; Remained unchanged at ¥16,800 as the industry's overall average. This figure is considerably lower than compared with the 37.7 % increase from 1974 to 1975 or 34.5% increase from 1976 to 1977.
5. Computer personnel; In the case of general users, the ratio of computer personnel to all employees in number is one to two percent for a company with 1,000 employees or more, and two to six percent for those companies with less than 1,000 employees.
6. Computer personnel's monthly pay; The fixed wage is ¥171,000 for a card puncher, ¥134,400 (7.2% increase over the previous year) for an operator, and ¥158,600 (5.8% increase) for a programmer, and ¥200,400 (5.8% increase) for an SE.

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW-TYPE TROUBLE MONITOR SYSTEM

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 74

[Text]

• Civil jumbo-jet airliner accident disasters cause big claims every year. They say they are mainly caused by combinations of trouble in mechanical equipment, engines, navigation aides, and air traffic control facilities. Particularly problematical among these recently, are illusions or maloperation by the pilot, and misforecasts of turbulent air at time of low-altitude flight.

Thereupon the Science and Technology Agency has engaged in trial production and research at the cost of a total of ¥200 million starting from 1975, because they thought it is necessary to (1) give pilots integrated and easy-to-see indicating instruments in order to lighten their burden and (2) establish a trouble monitoring system which predicts and warns of any trouble in the body, engine, and navigational system or of air turbulence around runaways in order to lower air traffic accidents.

The "integrated airborne display", produced on a trial basis, is aimed at providing the pilot rationalized information by use of the integrated airborne instruments, which display on a real-time basis, the necessary information on a color CRT screen. This system enjoys the greatly improved functions and performance of the conventional computer graphic system, and is partially provided with future trouble monitor system functions, such as those for monitoring normal flight proceeding at time of taking off and landing or other pilot operations. This system received good evaluation in tests executed by plane captains of the Boeing 747, etc., giving promising prospects for its regular use.

CSO: 4120

SCIENCE AND TECHNOLOGY

UNIFICATION OF CHINESE CHARACTER INFORMATION PROCESSING I/O SYSTEM

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 74

[Text]

* The Agency of Industrial Science and Technology entrusted the Japan Electronic Industry Development Association with research, starting from 1980, for standardization of Japanese language information processing mainly of Chinese characters. They now have finished their preliminary survey and began tests for various evaluations. This three-year project is aimed at unification by use of the new technologies for Chinese character I/O systems which used to vary from one process maker to another, and so far has forced them to be meaningless development endeavors.

First of all, the Agency of Industrial Science and Technology started standardization of the character array in the Chinese-character input unit and the character pattern in the output unit, aiming at cutting production costs of the makers, providing improvements for users, and simplification of the operator's functions.

The contents are: (1) looking through Chinese characters used in newspapers or magazines, to select and set the character kinds according to their usage frequencies; (2) studying relationships between the number of characters and the operation of a full-key type Chinese-character input unit and the idealistic character-key array, based on human engineering, and a Japanese character-key array of a Japanese character-Chinese character converter; and (3) developments of a Chinese character font of the low-density graphic elements (24 times 24) to be used in a line printer.

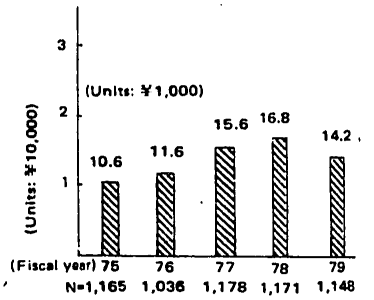


Fig. 1. Annual Change in Averaged Computer Expense Per Employee (All Industries Included)

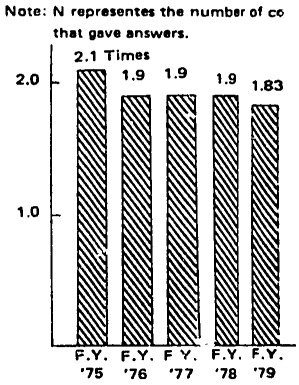


Fig. 2. Annual Change in Estimate of Computer Investment Increasing Ratio 5 Years Hence

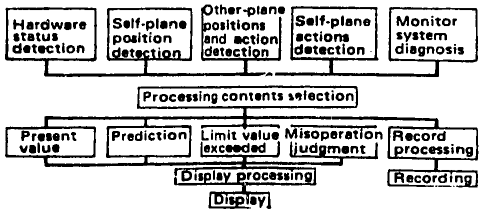


Fig. 1. Outline of Trouble Monitor System

CSO: 4120

SCIENCE AND TECHNOLOGY

MAGNETIC BUBBLE DATABASE MACHINE EDC

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 75

[Text]

The Electrotechnical Laboratory has developed the magnetic bubble database machine EDC (Electronic-disk oriented Database Complex or ETL Database Computer), which realizes the high-performance data base operations by its multiple microprocessors and the magnetic bubble storage unit. The basic principles taken into consideration in the design of the EDC are as follows:

(1) The rear hardware system is required: the problem can not actually be solved by the rear software system, in which the minicomputer is used only for the database system, and is connected to the parent computer. The bottleneck of the database can be broken only when parallel processing is introduced into the auxiliary storage unit and when the rear processor is combined into one with the improved auxiliary storage unit.

(2) Solid disk technology should be employed: The data base machine should employ the improved magnetic bubble storage unit in place of the conventional magnetic disk one (refer to the next item).

(3) It should be data model-independent: The database machine should employ such a system that the data model-independent basic database operational instructions are provided beforehand, so as to assist the database system by means of providing each kind of data model.

The systematical characteristics of the EDC can be summarized into two respects; the database processing-oriented design and the parallel processing. In the conventional database system, the storage unit in which the data are stored is accompanied by mechanical rotations, e.g. a magnetic disk; from which, commonly, a part of the database is transferred to the main storage, then allowing the processor to execute the processing consulting within the main storage. This results in the trend of ever-increasing main storage capacity, providing much redundancy as well.

Whereas in the database machine in which the magnetic bubble storage is employed, the magnetic bubble storage unit stores the data and is positioned on the same level as the main storage, being directly connected to the processor. This enables the EDC processor to perform on real-time basis by allowing the data to be read out from the magnetic bubble storage. Also, the magnetic bubble storage control employs in part the microprograming control system, which enables operations based on a series of microinstructions to be given from the processor in much the same way as the process can easily control the magnetic bubble storage.

The database machine which employs the magnetic bubble storage can surely encourage such expectations, besides also offering the speediness inherent to a magnetic bubble storage. Such are the improvements in processing speed over the conventional system made possible by means of the above-mentioned database processing-oriented design. The totally new improvement in processing speed can not but depend on parallel processing after all.

A storage unit such as a magnetic disk is essentially unsuitable to parallel processing because there is a trend (brought about by the attempt to keep prices per bit as low as possible) to decrease the number of units of the whole system by using the largest possible storage capacity per unit. The magnetic bubble storage also shares the same trend of decreasing the number of chips in the whole system by improving the integrity per chip as much as possible.

Nevertheless, for example, the 100-M byte (=800 megabits) system, which will be put up for sale soon, uses 200 chips of 4-M bit devices. Suppose that each chip combined with a microprocessor is a basic unit (data module), up to 200 basic units can exist for the 100-megabyte system. If they are connected and operated

with each other in parallel then totally new improvements in the processing speed can be expected.

Fig. 1 shows the architectural figure for an EDC which has been produced experimentally, based on the above concept. In it, eight basic units are connected to the common bus so as to operate in parallel. In each basic unit, such fruits of the development and the research in the field of parts and materials as a microprocessor pulse, a microprograming storage, and a magnetic bubble storage are employed on an overall basis.

Photo 1 shows the enlarged view of the basic unit. In it the five cards arranged to the right side constitute the magnetic bubble storage; the four cards of each being 256-kilobyte storage and a controller. Photo 2 shows the external view of the EDC II. The EDC II is provided on its front panel with 32 alphabetic characters x 8 lines LED display part for the operational status display, giving easy grasp of the processing flow.

The EDC uses model-independent high-level machine language, which enables easy composing of the database system and reliable software make-up as well. Also, the EDC realizes the user's interface EDCL by means of the relationship model which uses high-level machine language to have its compiler in the EDC itself. This enables the EDC to be used as an independent database machine without using the parent computer. Fig. 2 shows an example in which the EDC replies to the inquiry the user has made by use of the EDCL.

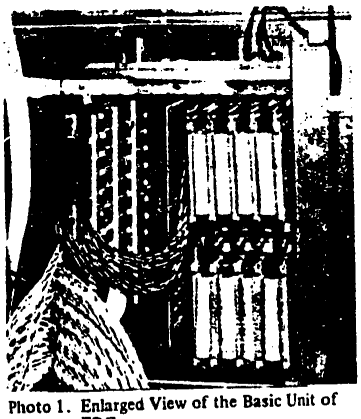


Photo 1. Enlarged View of the Basic Unit of EDC

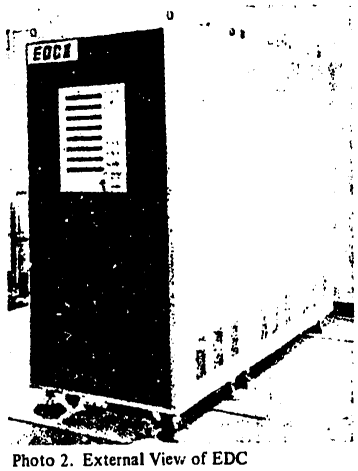


Photo 2. External View of EDC

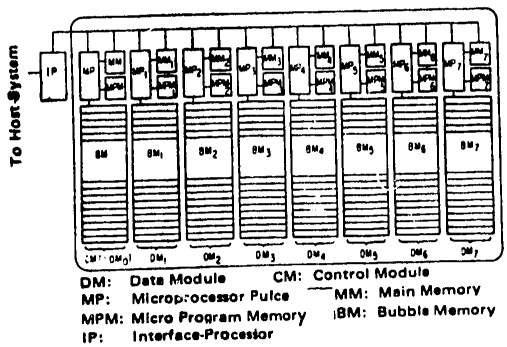


Fig. 1. Architectural Figure for EDC

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LIST AUTR(DNO,AUTHOR:AFFILIATION='ELECTROTECHNICAL LAB\')
     EDNO=DNO3TITLER(TITLE)

DNO     AUTHOR                  TITLE

77031   KIMURA,FUMIHIKO         AN INTERACTIVE GEOMETRICAL DESIGN SY
                                STEM WITH HANDWRITING INPUT
59028   TAKAHASHI,S.            ENGLISH-JAPANESE MACHINE TRANSLATION
59028   WADA,M.                 ENGLISH-JAPANESE MACHINE TRANSLATION
59028   TADEMURA,R.             ENGLISH-JAPANESE MACHINE TRANSLATION
59028   WATANABE,S.             ENGLISH-JAPANESE MACHINE TRANSLATION
59032   WADA,M.                 AN ELECTRONIC READING MACHINE
59032   TAKAHASHI,S.            AN ELECTRONIC READING MACHINE
59032   IIJIMA,T.               AN ELECTRONIC READING MACHINE
59032   OKUMURA,Y.              AN ELECTRONIC READING MACHINE
59032   IMOTO,K.                AN ELECTRONIC READING MACHINE
62181   ISHII,O.                A TUNNEL DIODE HIGH-SPEED MEMORY
62202   TAKAHASHI,S.            SYSTEM DESIGN OF THE ETL MK-6 COMPUT
                                ER
62202   NISHIMO,M.              SYSTEM DESIGN OF THE ETL MK-6 COMPUT
                                ER
62202   YOSHIMIRO,K.            SYSTEM DESIGN OF THE ETL MK-6 COMPUT
                                ER
62202   FUCHI,K.                SYSTEM DESIGN OF THE ETL MK-6 COMPUT
                                ER
65282   M.MITTA                 HIGH SPEED THIN FILM WOVEN MEMORY: C
                                ONSTRUCTION AND USE
65282   M.NISHIMO               HIGH SPEED THIN FILM WOVEN MEMORY: C
                                ONSTRUCTION AND USE

END READY
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Fig. 2. An Example of Inquiry and Reply

CSO: 4120

SCIENCE AND TECHNOLOGY

INDUSTRIAL FLUORESCENT FIBERSCOPE USING ULTRAVIOLET LIGHT

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 76

[Text]

* For the first time in the world, Olympus Optics Industries has succeeded in developing a fluorescent fiberscope for industrial use with a light guide system that uses ultraviolet light as the luminous source for the fiberscope.

Since the industrial fiberscope is a non-destructive inspection device, it will be just as important as X-rays or ultrasonics. Particularly, the use of ultraviolet light as a luminous source has the following advantages.

1) High illumination (phenomena can clearly be seen).
2) A fluorescent detection method can be used that can find minute flaws.

Ultraviolet light was regarded as one of the most powerful sources of light, but its practical use has not been achieved because it was difficult to transport light from the source to the tip of the scope.

The new industrial fluorescent fiberscope has a light guide to conduct light from the source to the tip of the scope. This light guide is a plastic tube enclosing a special liquid with both ends covered with quarz. It is included in the fiberscope and has a diameter of 11 mm.

The tip of the scope can be bent to 120 degrees in both upper and lower directions. The effective length of the scope is 1,280mm. and the observation distance is from 10mm to infinite by using the focus control system. The above is an overview of the new fluorescent fiberscope. The light source unit uses a 7A current and a 200w mercury lamp. This enables the operator to check for minute flaws in an object that has a complicated internal structure by using the fluorescent methods. It can be used for non-destructive inspection of industrial products, such as pipes, steel beams, and engines.

CSO: 4120

SCIENCE AND TECHNOLOGY

AUTOMATIC POSITIONING DEVICE FOR AN UNBALANCED POINT

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 76

[Text]

* Kokusai Measuring Instrument has developed an automatic positioning device for an unbalanced point. This device includes a stepping motor in the sensor part of the conventional balancing machine (balance test machine) and performs a full automatic test for balancing of a rotator.

The balancing machine takes an armature of a rotator, such as for a small motor, off the production line and measures its balance to determine whether modification is needed. As previously described, the automatic positioning device includes a stepping motor in the sensor part of the balancing machine that is linked to a vibration detector. This device can halt an unbalanced point (where weight is unbalanced) at any desired position or angle for modification.

Conventional balancing machines put a mark on a rotator and detects the angle of any unbalanced points by a luminous strobe or a photosensor.

The company says that, at the stage of trial manufacturing, the new device is compact and has a detecting speed 2 to 3 times faster than conventional systems. In addition, less manpower (5 to 10 fewer people) is needed to operate the device. Since the new device uses a no sensor/no marking system, it does not require marking or sensor detection.

CSO: 4120

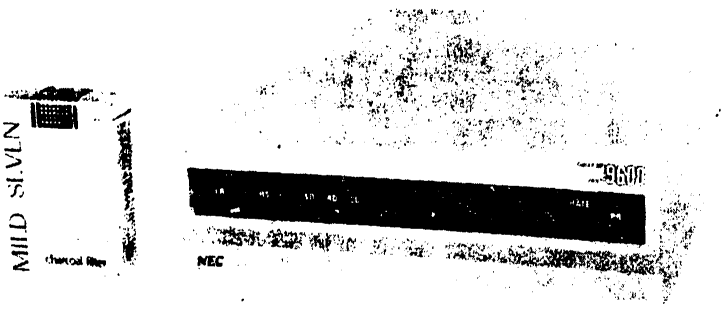
SCIENCE AND TECHNOLOGY

HIGHEST-SPEED POLLING MODEMS IN THE WORLD

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 77

[Text] *NEC has started to market the following new models of modem: DATAX SP9600FAST (transmission speed 9600 bits per second) and DATAX SP800FAST (4800 bits per second). Their polling response time is 15ms. DATAX SP2400FAST (transmission speed 2400 bits per second). Their polling speed is 7ms.*

A modem is a unit that converts digital signals into analog signals and vice versa. These new modems have a speed 2 to 10 times faster than conventional modems. This achievement derives from the fact that high-speed automatic equalization technology has been concentrated on the highly integrated LSI chips. In addition, these modems have achieved higher reliability through a total employment of various LSI's and a miniaturization which has been realized to render them one-third in size of conventional products.



DATAX SP9600

CSO: 4120

SCIENCE AND TECHNOLOGY

DEVELOPMENT OF SEMICONDUCTOR HYDROGEN GAS SENSOR

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 77

[Text]

Professor Hideo Tamura and Assistant Professor Hiroshi Yoneyama of the Applied Chemistry Course of the Faculty of Engineering in the University of Osaka have, with their colleagues, developed a semiconductor hydrogen gas sensor.

The semiconductor hydrogen gas sensor relies on the principle that it senses gas by using the variation of electric conductivity when gas is absorbed on a semiconductor.

This new sensor is a device that evaporates indium on both sides of a zinc oxide sintering object impregnated with palladium chloride solution and equipped with a lead. As to the responsiveness to methane, ethane, propane, and carbon monoxide for hydrogen gas, it is apparent that the sensor can respond to carbon monoxide only at below 120°C and that its response is smaller than that of hydrogen gas.

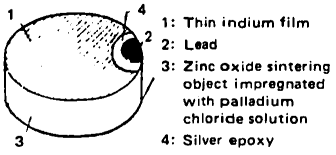


Fig. 1. Structure of Semiconductor Hydrogen Gas Sensor

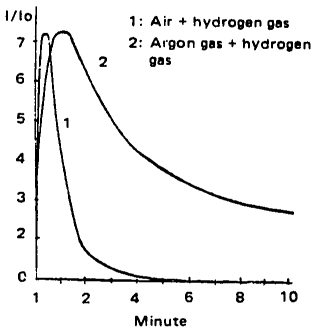


Fig. 2. Resposiveness to Hydrogen Gas

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SCIENCE AND TECHNOLOGY

SINGLE LOOP DISTRIBUTED CONTROL SYSTEM

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 77

[Text]

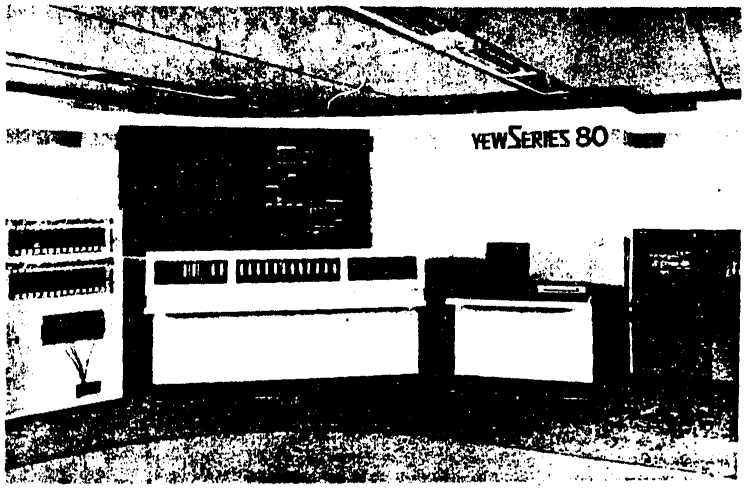
Yokogawa Electric Works have developed the YEW Series 80 Electronic Control Unit, a single loop distributed control system that fully uses microprocessor technology.

The components of this new system are as follows:

1) The basic control system includes a general purpose PID controller, a programmable controller, a recorder, a fluorescent bar graph incorporating alarm meter, a manual operator panel, a convertional temperature alarm, a programmable arithmetic unit, and counters.

2) The batch and mixed control system includes a batch set-up unit, a mixed controller, a batch controller, and an integrating meter.

3) The central monitor and communication system consists of a 14-inch CRT operator console, a printer, an interface unit, a communication interface adapter, and a 20-inch color CRT operator stage.



New System

CSO: 4120

SCIENCE AND TECHNOLOGY

ELECTRIC POWER GENERATION BY BURNING PLASTIC WASTES

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 80

[Text]

* The Plastic Waste Management Institute has decided as a new activity this year to start a project, entitled "Survey and Research for Efficient Reuse of Heat Generated from Disposal Furnaces for Waste Plastics", to generate electric power by using the heat of gases exhausted.

Because the exhausts from these furnaces include highly concentrated hydrogen chloride (HCl) more than 700ppm, it has rarely been reused, but recently, joint research by the Institute and Japan Zeon has accomplished suppressing the concentration of HCl in the exhaust, to less than 100ppm, and thus, the Institute is going to reuse the waste energy by the use of this technique.

The total cost of the task is about ¥30 million, one half of which will be subsidized by the Japan Bicycle Promotion Association.

According to the plan, heat of exhaust gases generated by burning large quantities of waste plastic is used to generate steam from water, and then to generate electric power. The technical problems are, (1) to decrease the concentration of HCl in the exhaust to prevent corrosion of boiler pipes, and (2) to increase pressure and temperature of steam to obtain higher efficiency for power generation.

The former problem may be solved by the use of the experimental results of burning waste plastics in a floating bed furnace of the thermal decomposition type, obtained by the above joint research. In the coming year the Institute will make an effort to develop the exhaust-gas power-generation system, centered on an experiment to increase boiler pressure and temperature by the use of the above technique.

CSO: 4120

SCIENCE AND TECHNOLOGY

TRIAL PRODUCTION OF INTEFERON

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 82

[Text]

* Interferon is now being spotlighted for beneficial effects, not only for the treatment of viral diseases but also for the control of cancer. Taken in the heated race for mass production of the drug, the Green Cross Corporation of Osaka plans to start trial production at industrial level in the coming years. In this project, a test plant for the production of 1,000 million units of interferon will be constructed at a site nearly the company's head office in Joto-ku, Osaka. If the trial production is successful, full sized plants will be constructed in the company's Osadano Factory in Kyoto.

Earlier, in the later part of the 1960's, the Green Cross, Toray Industries, Inc., and the Japanese Red Cross Society had set about to develop interferon. In March 1980, Mochida Pharmaceutical Co., Ltd. showed its interests into the drug by signing a technical contract with G.D. Searle of the USA. Takeda Chemical Ind. Ltd. was also quick into joining the race, while, in the mean time, the Science and Technology Agency was backing up the study for the development of excellent manufacturing methods. On the other hand, the Research Development Corporation of Japan has granted in January, 1980, a subsidy to the Green Cross and Toray, expecting that the researchers would find a key to the mass production of the drug by the fiscal year 1984. Interferon, discovered nearly 30 years ago by Taiichi Nagano and others of Japan, is a glycoprotein produced in extremely minute quantity when cells are exposed to viruses. In the early stage of research, the drug drew attention for its resistance-reinforcing effect on cells against viral infection. Several years ago, its anti-cancer properties were reported over the world. Now that the drug has been shown to be of great interest, companies and researchers are agonizingly trying to break through the bottleneck of extremely high cost of production.

CSO: 4120

SCIENCE AND TECHNOLOGY

CARBON FIBER DEVELOPMENT DESCRIBED

Tokyo TECHNOCPAT in English Vol 14, No 3 Mar 81 p 84

[Text]

* Mitsui Coke Kogyo Co., Ltd. has developed a new carbon fiber production technology using coal as the raw material, and plans to proceed with industrialization of the new method in cooperation with a spinning machine maker. Since most carbon fibers are made from petrochemical products, the company's carbon fiber is the first time it has been commercially made from coal. At present, various production processes are being examined in a test plant, and the company intends to start commercial production of 3,000 tons of carbon fiber annually in 1985.

* The company's carbon fiber is manufactured from solvent refined coal (SRC) produced by eliminating sulphur and other impurities. Industrially, it is used for non-polluting fuel or raw materials for various carbon products. The SRC production method was developed by Mitsui Coal Liquefaction Co., a subsidiary of the Mitsui Group. The company is carrying out test operations for industrialization in the test plant which has a liquefaction capacity of 5 tons a day.

Since coal costs much less than petroleum, the cost of manufacturing carbon fibers with the SRC method is expected to be one half or less that of using petroleum. Presently, two types of carbon fiber are produced: common type made from crude oil pitch and special type from polyacrylonitrile. The common type costs 5-8 thousand yen per kilogram with present techniques, but with the SRC method should drop to 1-2 thousand yen per kilogram. As SRC can use any kind of coal except anthracite, a larger and more supply of raw material exists than with petroleum.

CSO: 4120

SCIENCE AND TECHNOLOGY

STRONG SLUDGE PRECIPITATING AGENCY DEVELOPED

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 86

[Text]

* Japan Techno, a maker of drainage disposal equipment, has recently developed a strong sludge precipitating agent which is very effective in controlling bulking in drainage disposal systems.

Disposal of drainage by the active sludge process inevitably involves bulking because of the generation of Hyphomycetes, because of the inadequate quantities of loads and insufficient control of the quantities of oxygen, and because conventional coagulants have been used to control this bulking. However, coagulants have to be continuously injected, causing sludge to be carried over, and this incites a vicious circle: increased removal of excess sludge, diminished quantity of treated water, increased costs for disposal etc.

The strong sludge precipitating agent developed by the company does not necessitate conventional continuous injection. In particular, it shows high precipitating efficiency for molds which are slow to coagulate and it is cheaper than coagulants.

The new precipitating agent is ferromagnetic and it has to be injected in existing systems only once very year or two to achieve the following: 1) an increase in sedimentation, 2) stability of treated water, 3) a decrease in excess sludge and, 4) greater ease of maintenance.

CSO: 4120

SCIENCE AND TECHNOLOGY

TECHNOLOGY FOR DENITRATION OF EXHAUST GAS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 86

[Text]

* The progress of technology for systems for denitrating exhaust gas is commensurate with the progress of technology for denitrating catalysts. In the beginning, these catalysts were mostly pellet types. Recently, honeycomb types have become predominant. Also, the metals used for the catalysts, initially iron, copper, etc. have gradually been changed to vanadium, etc. which have high activity in low-temperatures.

These charges have developed catalysts which are more resistant to sulfur in exhaust gas, cause less choking with dust, and less pressure loss by dust, than those developed 5 years ago; and the temperature of catalytic reaction has been reduced by about 100°C.

The target makers have recently been aiming at is the establishment of technology for high-dust denitration intended for coal-fired heating. Denitrating systems have mostly been low-dust types which were installed behind electrical precipitators. High-dust types, in contrast, denitrate before electrical precipitators. The greatest problems in the denitration of dirty gases are choking of catalysts with dust and wear of catalysts by dust. For high-dust types, the "self-cleaning effect", (which means that small-particles or dust which choke catalysts are shaken off by large particles of dust), can be expected. Yet, the problem of wear caused by dust abrading the surfaces of catalysts still remains. There is an inversely proportional relation between the hardness of catalyst surfaces and the activity of catalysts if the surfaces of catalysts, are hardened the activity of the catalysts decreases. Thus, the key point here is how to develop catalysts with high abrasive resistance without decreasing their activity. On the other hand, methods have been devised such as that of regulating the gas at the inlet of the denitration system in order to allow the gas to flow at an angle, so that dust will least damage the catalysts; and such as that of placing dummies in front of catalysts. Further efforts are expected to be directed at making systems compact, elongating the life of catalysts and establishing technology for recycling catalysts.

If a further striking advance is desired, it will be necessary to overturn the current predominant idea of selectively reducing the amount of contained nitrogen by use of ammonium. In the industry, a new idea is emerging to establish whether or not we can make use of the fact that if carbon monoxide, instead of ammonium, is used as a nitrogen absorbent for non-selective reduction, the heat from the oxidizing reaction in the denitration process is 10 times that from selective reduction with ammonium. The idea is intended to increase energy efficiency by collecting this heat, and much is expected of efforts directed towards the realization of this.

CSO: 4120

SCIENCE AND TECHNOLOGY

SMALLER-SIZED AND ENERGY-SAVING DESULFURIZATION OF EXHAUST GAS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 86

[Text]

* Mitsubishi Heavy Industries has established the technology for reducing, by about 40%, the conventional size of scrubbers for exhaust gas desulfurization systems.

This advance has been made by improving the exhaust gas cleaning liquid dropping port and also by improving the quantity of the cleaning liquid and the method of its dropping. Also, another improvement has been made in the internal shape of scrubbers. These improvements have prevented any increase in pressure losses or decrease in cleaning effect resulting from rises in gas flow rates in the scrubbers.

On the other hand, for the system which is in operation for power generator No.1 at Shimonoseki Thermal Power Plant, the conventional quantity of water used in the exhaust gas desulfurization system has been reduced by 30% by installing a gas-gas heater at the outlet of the electrical precipitator and by putting exhaust gas through the exhaust gas desulrization system after reducing its temperature from 150°C to 90°C. The exhaust gas at 50°C, from the exhaust gas desulfurization system, is discharged from a flue after it is heated to 100°C by heat exchange with the gas-gas heater provided at the inlet of the system.

Mitsubishi Heavy Industries is at present at the laboratory stage in its intentions to develop its technology for reducing the size of scrubbers, and it hopes soon to put the into Technology application in real systems. On the other hand, for more than 1 year, the company has had experience in operation of reduced energy water requirement saving systems, and it intends to make efforts to combine both technologies together.

CSO: 4120

SCIENCE AND TECHNOLOGY

SURVEY OF EXHAUST GAS FROM ALCOHOL-FUELED VEHICLES

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 86

[Text]

* The Environment Agency has decided to start in fiscal 1981 a 4-year plan for surveying exhaust gas from alcohol fueled gas vehicles.

Alcohol fuel is attracting attention because of the saving of gasoline, which is likely to fail to meet demands in the future. While running tests, etc. of these vehicles are already being promoted, studies on their exhaust gas have been very slow. Thus the Environment Agency has decided to examine, before alcohol vehicles start to prevail, how many polluting substances alcohol-fueled vehicles produce compared with gasoline vechicles.

The substances, troublesome at present in automobile exhaust gas, are NOx, CO and HC. The new survey will check for new substances which have not been produced by gasoline vehicles. So far, only one such subtance is known: formaldehyde which causes the eyes to ache. If surveys detect any new substances, the Agency will condust studies and take necessary steps so as to start restrictions on exhaust gas immediately when required.

The survey, in fiscal 1981, will cover exhaust gas and corrosion converning conventional new vehicles, and in subsequent years, will cover the same in relation to used vehicles.

CSO: 4120

SCIENCE AND TECHNOLOGY

COMPOSTING OF SEWAGE SLUDGE

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 87

[Text]

The Japan Atomic Energy Research Institute has succeeded in the development of a technique for composting sewage sludge, wherein sludge is irradiated, sterilized, and fermented for composting, in order to effectively utilize unused resources and recover farmland fertility.

The new processing method irradiates dehydration cake to kill any pathogenic bacteria, and neutralizes parasite eggs and mixing seeds. The beneficial bacteria are then seeded and aerobic fermentation is made to analyze and quicken protein decomposition, resulting in organic fertilizer. The composting process is completed within two weeks.

Experimental analysis showed that: (1) a group of colon bacillus can be sanitized by cobalt-60 gamma radiation for sludge sterilization; (2) alkali treatment is made by alumina or a product composting type of dry substances to accelerate fermenting conditions; (3) isothermal fermentation (Fig.1.(a)) is move effective than adiabatic fermentation (Fig.1.(b)), and 50°C is the optimum temperature for fermentation; and (4) the occurrence of carbon dioxide gas, which becomes the fermentation index, returns a part of the fermented object to funciton as an initiator. Of the returning operation is repeated, the occurrence will be completed in about three days. The reaction rate of the organic carbon is 20 to 30%.

If fermented sludge is stored in open air for about two weeks and natured in natural fermentation, this type of fermented sludge can be used as organic fertilizer.

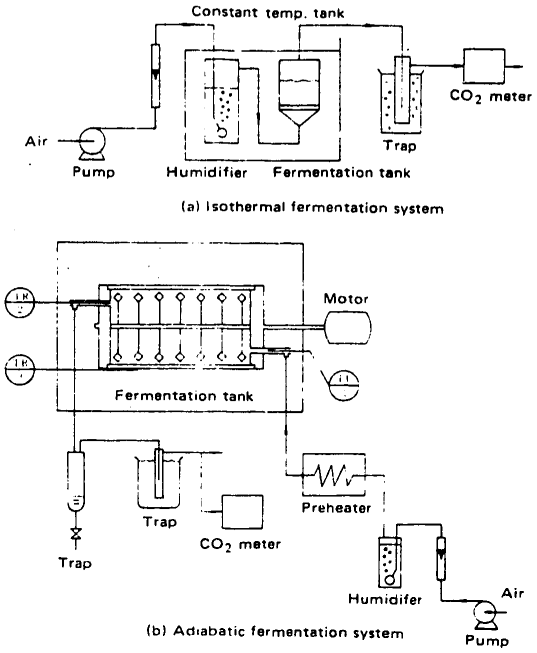
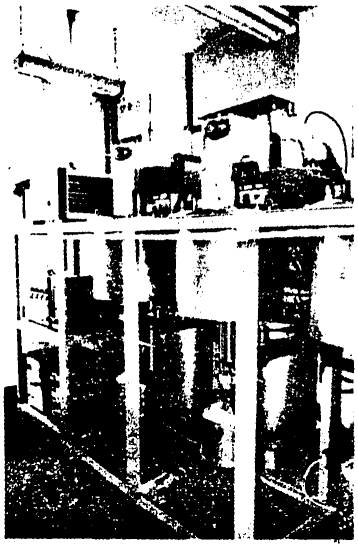


Fig. 1. Test Plant for Compost Making



Experimental Equipment for High-Speed Composting

CSO: 4120

SCIENCE AND TECHNOLOGY

COMPLETION OF SUPER-DEEP LAYER AERATION EQUIPMENT

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 87

[Text] *Hitachi Plant Construction Co. has announced the completion of a super-deep aeration facility, the largest of its kind in the world, with the ability to process 20,000m^3 per day. The facility shows high performance, economy and high efficiency in industrial waste water treatment.*

This super-deep aeration equipment is based on the technology of ICI in U.K., and purification is performed by a highly-efficient biochemical treatment process.

The Hitachi facility treats high-density waste water of pH6 to pH8, suspended solid 60ppm, BOD 160ppm, and COD 200ppm. If this waste water is treated by super-deep layer aeration equipment with an axis of the deep shaft with 2.8m in diameter and 100m in depth, purification can be accomplished to the level of suspended solid 10 to 18ppm, DOD below 10ppm, and COD 33 to 35ppm. This new equipment is provided with excellent economy and the capacity to process high-density waste water.

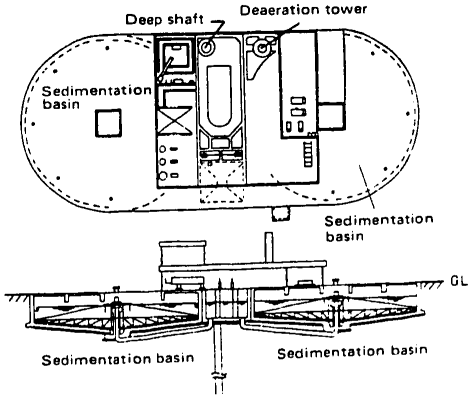


Fig. 1. Structure of a Drainage Treatment Plant Using New Deaeration Equipment

CSO: 4120

SCIENCE AND TECHNOLOGY

SIMULATOR FOR SUBMERGIBLE OPERATIONS IN 2000M DEPTH CLASS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 88

[Text]

* The Marine Technology Center is building "Shinkai (Deep-sea) 2000", a deep-sea submergible with a maximum operating depth of 2000m, which they are planning to complete by the end of October 1981. The operation of submergible is very complicated, as it includes such operation as navigation, communications, life support, as well as monitoring, evaluation and adjustment of sensors of electrical and hydraulic equipment in addition to ascending, descending and other functions. These jobs have to be carried out almost simultaneously and very carefully. If a real submarine were used to provide training, it would not only cost much in terms time and money but also always involve a certain element of risk. Thus, the center has manufactured a simulator for the submergible in order to train prospective crews.

Items of simulated training consist of three groups as follows: normal operations (descending, ascending, sea bottom landing, taking-off, navigation while observing the sea bottom through windows, and cruising along the sea bottom while observing instruments), emergency operations (taking measures in the event of accidents, taking measures in the event to equipment trouble and emergency ascent) and communications and guiding etc. (periodic and emergency communications between the mother boat and the submergible, and guiding and following the submergible by the mother boat up to a destination). Training in these courses is designed in such a manner that visual, tactile, aural and physical senses will be brought together. Results of training will be evaluated on-line and off-line. The simultaion's system consists of the components as shown in Fig.1.

Submergible Simulation Unit :—

This is a simulated version of the pressure withstanding shell of the real surveyor in order to train each trainee in it. Instruments provided in it are exactly similar to those in the real surveyor. Signals for all operations including those of switches and the control column are input in the computer and displays by meters and lamps are all output by the computer.

Sea Bottom Vision Simulating Unit :—

This is a simulated sea bottom vision seen through the observation windows. A sea bottom model is projected by a TV camera and which moves freely in accordance with movement of the submergible, and is projected onto a screen in front of the observation window.

Sound Simulation Unit :—

This is a simple simulation of the sonar group. It is designed to vary artificial sounds and the control of submarine conversation in accordance with the movement of the surveyor.

Control Desk :—

This is designed to determine training conditions and display of the trainee's performance during training. It is attended by an instructor who gives instructions and makes evaluations. Also, it plays the role of a mother boat and gives instructions to the submarine.

Computation Control Unit :—

This is equipped with a digital computer to perform calculation upon recipt of input signals from the submergible simulation unit and the control desk, and outputs to all component units to control them.

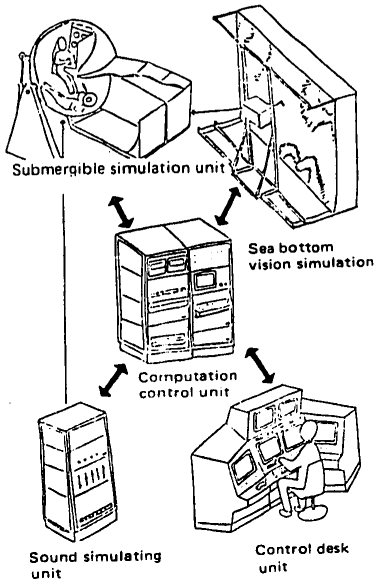


Fig.1 Structure of Simulator for the Submergible, "Shinkai 2000"

CSO: 4120

SCIENCE AND TECHNOLOGY

MAKING CONTINUOUS MARINE MEASUREMENTS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 88

[Text]

* The Applied Dynamics Laboratory of Kyushu University is studying the method of making marine measurements using an integrated buoy system. As part of this study, the laboratory carried out continuous measurement of current velocity direction and depths of different layers in currents using the integrated buoy in strong Japan Black-Current areas.

The buoy system, held by a specially reinforced nylon rope about 950m long, holds 5 instraments and one tidal-power meter, which are able to automatically measure current direction velosity, water temperature and depth continuously. The system is secured to the sea bottom by a 2.4t anchor to which the rope is attached. The rope is also provided with 30 floats so as to be positioned nearly vertically with the aid of their buoyancy.

The laboratory carried out continuous measurement at 10 minute intervals at a water depth of 1000m at 3 locations for 1 month. Data obtained was recorded on cassette tapes. Reportedly, the test has obtained new findings including the fact that typhoons reduce water temperature by 4 5 degrees and temporarily decelerate surfacial water currents.

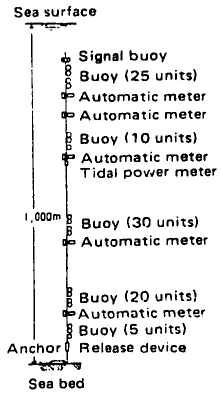


Fig.1 Integrated Buoy System

CSO: 4120

SCIENCE AND TECHNOLOGY

SSC TYPE MARINE RESEARCH SHIP

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 89

[Text]

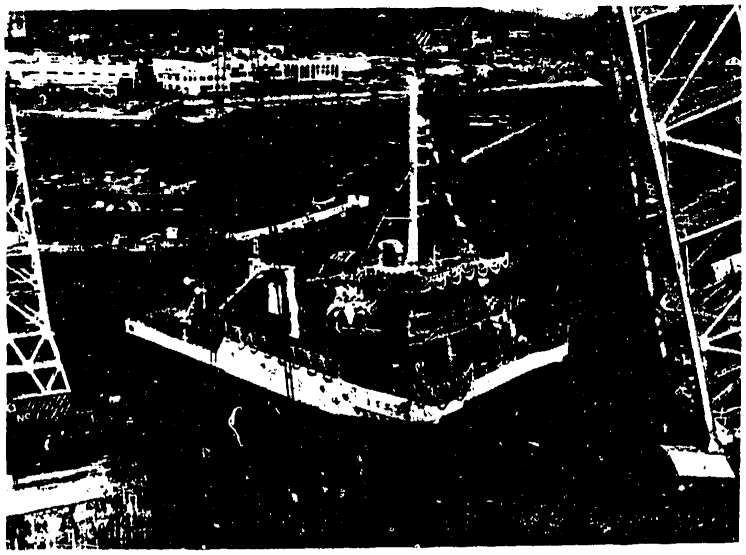
The semi-submerged catamaran (SSC) marine research ship named "Kotozaki" has been completed and launched by Mitsui Shipbuilding and Engineering Co.

This catamaran has a totally different shape from conventional ships. It has a torpedo shaped lower hull that rides below the water and a super structure combined with two plates with a streamlined cross section.

The newly designed structure has the following features:

1) high stability in rough seas
2) constant speed is easy to maintain
3) wide deck area

This ship will be used to check water quality and study the sea bed structure of the western ocean area of the Seto Inland Sea between the Sea of Subo and the Bungo Strait.



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SCIENCE AND TECHNOLOGY

SCIENCE AND TECHNOLOGY AGENCY'S PROJECT FOR STUDYING PROCESSES FOR MICROBIC CONVERTION OF WOOD BIOMASS

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 92

[Text]

* The Science and Technology Agency will start a 6 year project beginning in fiscal 1981, for research and development of processes for microbic transformation of wood biomass. This is intended to be part of the "specific general studies on the utilization of biomass energy resources (various organic resources)" which is to be started by the Ministry next year, as one of the themes of specific general studies. It aims to establish methods of turning wood resources into alcohol (ethanol).

Wood resources, such as natural wood and wood waste, were once used as just firewood and charcoal, accounting for the most fuel used. Recently they accounted only 0.1% (as of 1977) of total fuel energy. The Forestry Agency estimates the energy net annual production (total growth quantity) of the Japanese forestry has to be 140 million kl in terms of oil, which represents the largest biomass resource. This implies that a considerable part of this energy is wasted. These circumstances have recently induced trends to utilize wood as a fuel by turning it into ethanol.

The method used for this purpose is saccharifying cellulose with the aid of enzymes and thus turning it into ethanol by fermentation. However, wood contains lignin, by as much as much as 25%, which is distributed in complicated 3-dimensional networks and is very hard to dissolve. Because of this lignin, acting like an adhesive hinders saccharification, the first step of the conversion, and for which no techniques have yet been established successfully. Meanwhile, the Institute of Physical and Chemical Research has recently discovered a highly alkaline bacteria which dissolves lignin and produces methane, ethane and various organic acids. Thus, the study the Agency will start next year, as an extension of this discovery aims to complete saccharification techniques by developing techniques for enabling the saccharification of cellulose and the dissolution of lignin to concur.

Although it is still at the elementary stage, studies of the Institute suggest the possibility of causing saccharification of cellulose and the dissolution of lignin in the same reaction tank. Thus, the Agency intends to develop a new semi-continuous saccharification process. It is generally recognized that continuous methods are better for saccharification and fermentation of cellulose. However, the Agency observes that with a continuous system, it is difficult to control reaction speed and thus, the semi-continuous system which supplies wood chips continuously into the reaction tank which allows the saccharification of cellulose and the dissolution of lignin to concur and takes out the reaction products intermittently is more advantageous in many ways.

The Agency plans to complete a reaction process in 3 years before 1983 and manufacture a pilot plant, and carry out operations and data analysis in 3 years from 1984 in preparation for practical use from 1986 on.

CSO: 4120

SCIENCE AND TECHNOLOGY

MINISTRY OF AGRICULTURE, FORESTRY AND FISHERIES ORGANIZING GENETIC ENGINEERING RESEARCH

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 92

[Text]

* The Ministry of Agriculture, Forestry and Fisheries has started to organize genetic engineering research which is expected to be the greatest new technology in the fields of life science. In order to make the most of its efforts in such studies, the ministry has begun with organizing a seminar, held recently, consisting of 7 experts in the related fields.

Genetic engineering through its success, e.g., in allowing colibacilli to produce new anti-cancer and anti-virus drugs by planting human genes in colibacilli, is attracting much attention in the development of pharmaceuticals. Its applications, however, are not limited to pharmaceutical development but extend to the production of food, development of new agricultural chemicals, stockbreeding, etc., which are largely covered by the Ministry's domain. Possible developments, for example, may be the development of agricultural products which require no fertilizers, continuous production of protein resources by tank culture, etc., which are considered to be likely to have a great effect on the future of the agricultural and stockbreeding industries. Individual studies in the field of genic engineering have been conducted by several research agencies, such as the National Institute of Agricultural Sciences, and the National Food Research Institute, with good results appearing including a success in allowing colibacilli to produce soy bean protein.

Under these circumstances, the new seminar has been established as mentioned earlier, because the Ministry has reached the conclusion that from a synoptic point of view, extensive research and development is necessary.

The "seminar for promoting the study of DNA rearrangement by the Ministry of Agriculture, Forestry and Fisheries" is composed of 7 experts including K. Shibata, a member on the Agricultural, Forestal and Fisheriess Technological Committee, H. Saito, professor at the Institute of Applied Microbiology of the University of Tokyo and K. Watanabe, professor at the Medical School of Keio University.

At the meeting, the seminar discussed the following themes: 1) in which direction the Ministry of Agriculture, Forestry and Fisheries should develop genic engineering; 2) how study systems should be organized; 3) how researchers should be trained; and 4) safety measures. The Ministry intends to continue discussions on these themes for one year, form practical study projects, and study systems in request budget provision for 1982 at the earliest.

CSO: 4120

SCIENCE AND TECHNOLOGY

MAFF WASTE LIQUID TREATING FACILITY FOR JOINT USE

Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 93

[Text]

The outline of the waste liquid treating facility, recently delivered to the Ministry of Agriculture, Forestry and Fisheries by Mitsubishi Heavy Industries, is as follows:

A chemical with the admixture of a radioactive substance (tracer) is sometimes administratered to animals and plants to study their absorption of nutriments and heavy metals, and the distribution of special substances in their bodies. Such a process in also used for other studies in agriculture, forestry and fishery. Waste liquid produced at places conducting these studies contain radioactive tracer and it cannot, therefore, be discharged untreated, because its sources are the apparatuses used to treat and examine these animal and plant bodies, or to wash the instruments. It is, therefore, necessary to install waste liquid treating facilities to satisfy fully the restrictions on allowable concentrations of radioactive isotopes as prescribed for exhausts and waste water by the Agency of Science and Technology Notification No. 22.

The whole of the waste liquid treating facility completed by Mitsubishi Heavy Industries is housed in a single building and it includes shielding equipment, ventilating equipment and radiation monitoring and analyzing equipment. The apparatus, with the exception of some instruments, is operated by a central monitoring, controlling and operating system, thereby minimizing the exposure of people to radiation.

As to equipment, the external appearance of the evaporating and concentrating unit is shown in Photo 1, and the process flow is shown in Fig 1.

The characteristics of this facility are as follows:

(1) An optimum system is formed according to the radioactive levels of waste liquids, as an evaporating and concentrating unit with high decontaminating capacity is used to treat medium-level waste liquid and a counterosmotic unit with medium decontaminating capacity is used to treat low-level waste liquid.

(2) The evaporating and concentrating unit is of the forced circulation type so as to prevent the clogging or concentrate liquid.

(3) Low-level waste liquid can be drastically decreased by treating concentrate liquid in the counterosmotic unti still further by the evaporating and concentrating unit.

(4) The process is made safer still by installing a desalinating tower for after-treatment.

(5) To minimize the exposure of workers to radiation, all equipment with the exception of some instruments are operated by a central monitoring, controlling and operating system. Also, to facilitate operation, the main instruments are automatically operated by means of a master switch.

(6) Various monitors are installed for the purpose of monitoring exposure doses for workers and for monitoring radiation dosage for the precinct of the treating facility. Further, rooms at high radiation dose levels are shielded with sufficiently thick concrete walls. Thus, the incorporates every precaution for protection against radiation.

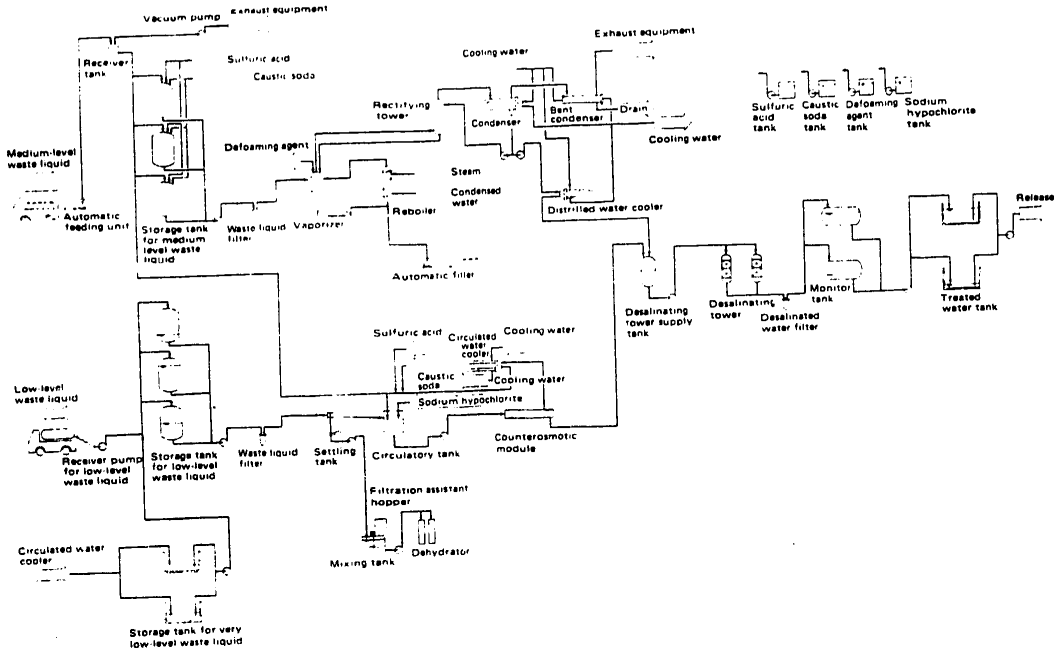

Fig. 1. Process Flow Sheet

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SCIENCE AND TECHNOLOGY

BRIEFS

WORLD'S LARGEST 6000KW LNG COLD POWER PLANT--Osaka Gas Co., Ltd., as part of LNG cold utilization, will construct the world's largest power plant of this sort. The project will begin in June for by the end of the year completion, and it will cost a little more than one billion yen. Seeking post-oil alternatives, electric and gas companies have been keen to introduce LNG, and this has resulted in the present planning of construction details for cold generating plants. These power facilities are to be mounted on LNG vaporizers and are to generate electricity during the vaporizing operation in an effort to reduce evaporation costs. Osaka Gas already possesses a 1450kW cold plant which adopts the Rankine cycle with propane as its medium. The new one will employ a dual system by combining with the conventional method to use as its medium a direct expansion technique that vaporizes pressurized LNG with seawater, turning a turbine by means of the resultant expansion pressure. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 56]

REACTOR EXPORT PLANNED--The Ministry of International Trade and Industry (MITI), as part of its promotion of the domestic nuclear industry and of its intensification of export structure knowledge, will by around the mid-'80s work on the realization of exportation of domestically-made nuclear power plants. While electric power companies in Japan are striving for plant sites, the domestic nuclear reactor industry is steadily cultivating ability with accumulated export potential. In the meantime, its demand is on the increase among developing nations and others, and this has stimulated MITI to encourage power plant export. Exports of reactors, MITI intends, will be centered on light-water reactors for the time being, and the technology of reactor manufacturers should be still more refined. Additionally, nuclear regulations, along with varying arrangements at home and abroad which are regarded as "critical conditions," are also to be under study, thereby clearing barriers to exportation. At present, the Nuclear Non-proliferation Treaty--an international pact on the peaceful use of nuclear power, the Japan-U.S. Atomic Energy Agreement, as well as other bi- and multi-lateral agreements, are restraining Japanese nuclear activities in various fields. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 58]

DRY-CLEAN PLANT WORKER'S CLOTHES--As one of the countermeasures to cut radioactive material release from nuclear power stations, Hitachi Ltd. is introducing dry-cleaning for clothing worn by site workers. Currently, the Toshiba Corporation has established a procedure to treat wash-water waste of a power plant by condensing and solidifying it without discharging it from a plant site, and the system was adopted for Fukushima Daiichi (First) as well as Fukushima Daini (Second) nuclear power station of the Tokyo Electric Power Company. On the contrary, Hitachi is trying to entirely eliminate water and employ dry-cleaning, in the attempt to cope with the laundry waste water problem. Such a washing of laundry has detergent suds that prevent sound condensation of the liquid waste, with the result that it is being diluted with seawater for draining. Hitachi's dry-cleaning method is basically the same as that of city launderers, except that the new system will prevent radioactivity from leaking in case of radioactive contamination of overalls, gloves and socks for cleaning. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 58]

DEVELOPMENT OF AUTOMATIC CONTROL SYSTEM FOR PWR PLANTS--The Mitsubishi Electric Corp. has started to develop a fully automated system for nuclear reactor instrumentation and operation control, in order to ensure safety of PWR nuclear power plants, and it will build a prototype at its Kobe Works to serve both for experiments and for demonstration to users. Compared with BWR, the PWR type has been considered structurally less dangerous with respect to radiation exposure to reactor operators and maintenance workers, and it has thus far required little automatic instrumentation or operation control. As reactors become larger and more complicated, needs for such systems will rise in an attempt to reduce the operator's burden and to improve the availability factor; Mitsubishi Electric has decided to respond swiftly to the request. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 58]

MANGANESE OXIDATION IN MOLTEN IRON--The rate that manganese in molten iron is oxidized by slag was investigated by measuring the change of manganese and oxygen content of molten iron covered with Fe_tO(+MnO)-CaO(+MgO)-SiO_2 slag in a magnesia crucible. Experiments were carried out with slag having various levels of basicity (=(CaO+MgO)/SiO_2), from 0.37 to 1.49 and Fe_tO content from 24 to 75 wt% at 1600°C. The oxidation reaction of manganese proceeded comparatively slowly except in the initial period, and equilibrium between the molten iron and slag was not reached within 60 minutes. Experimental results were interpreted by a rate equation derived from the assumptions that the reaction rate was controlled by the transfer of Mn. O, (MnO) and (FeO) in the boundary layers, and the driving force of the reaction varied with proceeding of the reaction. The effect of Fe_tO content of the slag on the reaction rate was observed more clearly in the driving force than in the mass transfer coefficient. The effect of slag basicity on the reaction rate was not clear. [S. Sinozaki, et al.: Tetsu-To-Hagane, 67(1981), 70] [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 60]

CHANGE IN SOLIDIFICATION OF IRON ALLOYS--A mathematical model with special respect to peritectic transformation has been given on formation of a negative segregation zone during unidirectional solidification of iron alloys. The model has been developed for both cases of equilibrium and nonequilibrium solidification. The analysis predicts that a solute-depleted band is formed in the vicinity of the

section of area reduction. The reduction ratio of cross section and carbon concentration are suggested to influence the intensity of segretation. It is concluded that the negative segregation is caused by the mass flow of solute-rich fluid in the interdendritic region to feed solidification contration. [H. Nomura, et al.: Tetsu-To-Hagane, 67(1981), 80] [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 60]

CASTING CONDITIONS ON SOLIDIFICATION OF STEEL--Effects of high withdrawal rates, fluid mold slag, and mold taper on the occurrence of breakouts or surface cracks of strand cast slabs have been evaluated by using an elasto-plastic stress analysis model developed previously. The model has made it possible to predict air-gap formation, and hence hot-spot formation at the corner portions of the shell/mold boundaries, as well as the stress mode in the shell. Selection has been made of casting conditions which minimize hot-spot formation and yield compressive stress in the shell. Commercial-scale casting experiments carried out on a Voest type straight mold and a Mannesmann type curved mold have confirmed that the chosen conditions are effective to prevent breakout and crack formation of the shell. A mechanism of formation of longitudinal corner cracks and longitudinal facial cracks has also been discussed. [K. Kinoshita, et al.: Tetsu-To-Hagane, 67(1981), 93] [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 60]

RECRYSTALLIZATION OF CU-AL ALLOY--The TTT diagram for recrystallization of a cold-rolled Cu-10at%Al alloy was depicted from the X-ray diffraction data. On the basis of the TTT diagram, two-step annealing procedures were adopted for investigating the effects of recovery and short-range ordering of recrystallization-texture development. Application of preliminary annealing (primary annealing) at temperatures below 583K prior to recrystallization annealing (at 673K for 480s) enhanced the development of the major component of the recrystallization texture and decreased the intensity of the minor component. Primary annealing at 503K showed the most significant effects on recrystallization. Shorter primary annealing at this temperature suppressed the development of the major component, whereas prolonged primary annealing enhanced it. This may be due to the competition of recrystallization with short-range ordering in the recrystallization front region. A slight increase of the major texture component in the specimens primarily annealed at temperatures higher than 583K, may have arisen from nucleation of the component prior to that of others. [A. Okada, et al.: 45(1981), 111] [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 62]

MIXED CAR PRODUCTION LINE--With a view to rationalizing the production process, Isuzu Motors has decided to establish a system for manufacturing plural numbers of passenger cars in a single line and has decided for this purpose to introduce robots into the welding line. The recent introduction of 28 robots into the welding line at its Fujisawa works is the first step in this policy, and the firm is planning to produce the three models of car in a single assembly line as early as 1981, by mounting Jemini cars on the line used in the production Asso and J cars. The greatest task facing the car manufacturing process at present is how to give variety to the cars manufactured while ensuring the benefits of mass production. Realization of this task will bring the automobile industry a twin benefit reductions in car manufacturing costs coming from scale merits; prevention of a drop in the line operating rate at a time when sales are slack. Isuzu Motor's decision to go ahead with the mixed production line of three models of car is based on exactly such a management principle. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 64]

TRIAL MANUFACTURE--Honma Laboratory at the Engineering Department of Tohoku University has succeeded in the manufacture of gold magnet. Going on the theory that the best way to turn gold of a non-magnetic dispersing medium into a magnet is to educe a strong magnetic element the laboratory mixed 60% to 95% gold with high magnetic elements (iron, cobalt, nickel), dissolved the mixture, and left the molten metal to educe and age. Some of the mass was further subjected to cold swaging processing. With respect to the magnetic force, range of dissolubility, state of separation into two phases and workability, a gold-iron-cobalt alloy of 88% gold and 12% iron cobalt showed the best results. Educing and aging alone can give it a maximum energy of 3K Joule per $1m^3$, and an addition of swaging processing gives it a magneticism of 8.2K Joule. The magnet is equivalent to 21K gold and it has a luster quite similar to gold. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 64]

MACHINE TOOL EXPORT CARTEL--The Japan Machinery Exporters' Association enforces the cartel for machine tool export to Europe as follows: 1) the term of validity: from January 1, 1981 to December 31, 1981; 2) the lowest export price is set in Yen; 3) the subject countries number 15: Belgium, France, Italy, the United Kingdom, Denmark, Holland, Ireland, Lusemburg, Norway, Sweden, Spain, Greece, Austria, West Germany and Switzerland. On the other hand, the export cartel for Canada and the U.S. is prolonged for the period from January 1, 1981 to December 31, 1981, with the following alternations: 1) the lowest export price is set in Yen as distinct from conventional $; 2) the lowest basic prices are raised 7% and 2% for machining centers and NC lathes respectively. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 66]

GENERAL PURPOSE PRESSURE SENSOR--Toshiba has succeeded in developing a general purpose pressure sensor that electrically detects pressure from the strain on a silicon semiconductor. This semiconductor pressure sensor creates a 4mm diffusion resistance layer on the silicon semiconductor substrate by using IC production techniques and makes it operate as a strain detection resistance. In addition, the temperature compensation circuit for sensitivity and zero-point variations is integrated and included on the substrate to allow for simultaneous measuring of temperature and to allow for corrections. The entire sensor is 1cm in diameter and can measure up to two atmospheres. If the signals of the temperature compensation circuit are fetched, the temperature can be measured. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 70]

SINGLE-PACKAGE MULTICHANNEL PHOTO-COUPLER--Sharp Corp. has developed single-package multichannel photocouple that reduces the installation space needed and thus can be added to microcomputers used for process control. Sharp will begin test marketing the "PC-800 Series" consisting of four channels, 4, 3, 2 and 1. This new product has a 5KV AC input/output insulation-proof sensor, and the double transfer mold package was used for it. In this package, conventional silicon resin is replaced by special transparent epoxy resin and then remolded with an opaque epoxy resin. The package is a small DIP type and has four pins per channel. The ratio of current transmission is 50% maximum at 5mA. The sample price is ¥140 per channel. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 70]

RADIO-WAVES ABSORBER--Mitsubishi Electric Corp. and NTT (Nippon Telephone and Telegraph) have developed in cooperation, a rubber-based radio-wave absorber in which the carbon fiber is employed. This absorbant material comprises polyofine liquid rubber in which is mixed about 1mm-long carbon fibers, and having puramid-shape hollowed tetrahedral cones laid on their surfaces. The size of the tetrahedral cone depends on the frequency to be absorbed; a cone 3 cm at the base and about 6cm in height is used when absorbing microwaves of 3.6 GHz or more. The higher the frequency, the smaller the size of the cone. And they are developing about a 2-cm-high absorber to absorb sub-millimeter waves, and which provides the wider absorbtion band as compared with conventional ones using ferrites mixed in rubber. It also has excellent durability, they say, with standing 10 years of more of outdoor use in an accelerated lifetime set. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 72]

COMPLETING NATION-WIDE NETWORK IN 5 YEARS--The NTT (Nippon Telephone and Telegraph) has announced its plan to start services of their "Subscriber Facsimile Communication System" beginning from the end of 1981 and to complete a nationwide communication network in about five years. The subscriber facsimile communication system is a facsimile leased communication network that uses a storage converter and high-speed digital communication line. Its features are, besides providing low-cost services, the ability to simplify communications or provide multiple address communications between itself and other facsimile units. The decision to complete the nation-wide network in such a short time as five years was made in order to solve an imbalance in their interregional services as early as possible, at the same time as utilizing its features as a high-speed transmission line. Upon completion of the system, they expect a great deal of latent demand will develop. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 72]

NEW TYPE POLLING MODEM--NEC has developed and put on sale the world's highest-speed polling modems. Rapid popularization of data communications has drawn into the main current the multipoint system. With this system, a line having several branchpoints in it, is used as an efficient and economic method for communications. However, since the multipoint system both sends and receives data as it carries out polling, i.e., by making sequencial inquiries regarding existence of transmitted data from the control station to terminals, a decrease in polling response time has been regarded as most important to improve communication efficiency. This has led to a greater need for a high-speed polling modem. NEC this time has newly developed three modems models; one of 9600 bits/sec communication rate, and 15 m/sec polling response time, another of 4800 bits/sec and 15 m/sec, and a further unit of 2400 bits/sec and 7 m/sec. In size, they are about one-third of conventional units. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 72]

SOLID SHAPE MEASURING INSTRUMENT--The Physical and Chemical Research Institute, jointly with Fuji Photographic Material Co. has succeeded in developing a simplified model of a solid shape measuring instrument using the scanning moire method. The measurement of an object shape by moiretopography was made based on the generation of moire stripes. Two lattice figures are projected on the object, and the shape is analyzed from the image received. The new instrument generates virtual moire stripes in the computer and automatically measures the irregularity

of an object by signal processing of the lattice figures detected in image elements. The prototype projects a 0.5mm pitch lattice figure 1.8m forward for analysis of scoliosos. The available range of measurement cannot exceed 1m in height and 60cm in width. Imaging takes about five seconds. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 76]

CARBONIC ACID GAS LASER PROCESSING UNIT--Osaka Transformer Co. has completed a carbonic acid gas laser processing unit with an output of 2kW. This unit has been developed in technical cooperation with TWI (Technical Welding Institute in England). The laser light has a wavelength of 1.6μ and a converging beam diameter of 0.2mm, and high energy density can be obtained. For 6.5mm thick steel, the welding width is less than 1mm and cutting width i. 0.4mm. Welding speed is 5m per minute for 2mm steel and 0.4m per minute for 6.5mm stainless steel. Cutting speed is 8m per minute for 1mm steel, and the conversion efficiency from electricity to light is about 25%. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 3 Mar 81 p 76]

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