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Japan Report

(FOUO 48/81)

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JAPAN REPORT

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CONTENTS

ECONOMIC

MAZDA SMALL CARS, TRUCKS TO BE EXPORTED TO LIBYA

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 964, 21 Jul 81 p 8

[Text]

Sumitomo Corp., one of Japan's top traders, has won a provisional order from the Libyan Government to supply subcompact passenger cars and pickup trucks made by Toyo Kogyo Co.

The tentative deal, expected to be formalized soon, calls for Sumitomo to export 30,000 Mazda vehicles, worth some ¥30 billion.

This will be the second automobile sales to the country made by Japan after a one-year export stoppage that lasted until late 1980.

The preceding contract was concluded by Honda Motor Co. last December for supply of some 12,000 subcompact cars.

The exports by the Sumitomo-Toyo team and Honda Motor, taken together, will account for more than 40 per cent of Libya's total automobile imports estimated at some 100,000 vehicles a year.

The Kaddafi regime of Libya instituted a trade nationalization policy in 1979 on its 10th anniversary. In 1980, it forced private trading enterprises to join state-run corporations, and at the same time, it informed foreign automakers that it would not permit them to export their vehicles to Libya unless they put up repairing costs and supply parts and components.

The demand invited a harsh reaction from the Japanese automakers and resulted in a virtual halt of exports to the country for the subsequent one year or so.

After mutual concessions, Honda consummated a deal last December to sell some 12,000 vehicles. Shipments of Honda cars began last March.

While selling some 10,000 cars to East Germany in late May, Sumitomo doubled its car sales to Chile in the January-June period over a year earlier.

A Sumitomo spokesman said, "Successful conclusion of the deal with Libya will enable the company to boost its overall auto exports in fiscal 1981 by 20 per cent over a year earlier to some 450,000 vehicles."

CSO: 4120/290

SCIENCE AND TECHNOLOGY

CURRENT TRENDS IN CMOS RAM MARKET DESCRIBED

Tokyo NIKKEI ELECTRONICS in Japanese No 266, 8 Jun 81 pp 92-101

[Text] The market for the CMOS [complementary metal oxide semiconductor] RAM (random access memory) is expanding. The main previous applications were battery-operated or nonvolatile memory with battery backup during data storage. These included the ECR (electronic cash register) and POS (point of sales) terminals. Recently, in addition to these applications, there has been a tendency to use CMOS for power-source miniaturization. In areas such as office automation equipment where miniaturization is imperative, it is essential to reduce the size of the power source by eliminating cooling fans and other problems. For the same reasons, there is a trend toward using the CMOS RAM as the main memory of microcomputer systems. One particular application being examined is that of temporary memory for fast transmission of VTR. There is a large market even when just one 16 kilo-bit RAM is used per set. Even in applications to nonvolatile memory, it is expected that the CMOS RAM will be used increasingly to replace core memory and EPROM (erasable and electrically programmable read-only memory).

How much will the demand grow? According to the U.S. journal, ELECTRONICS, the consumption in the United States grew 3.8 times from 1979 to 1981. By 1984 it is expected to increase to 3.5 times the figure for 1981.[1] At present, CMOS devices account for one-fourth of the MOS static RAM market. In 1984 they will be about one-half (the two together will come close to the dynamic RAM). The number of 4 K CMOS RAM's shipped throughout the world grew from 5 million to 13 million in the period 1979 to 1980 (source: Data Quest Company of the United States; this is the rate of increase but domestic manufacturers believe the absolute number is three or four times this). In 1981, as the movement to the 16 K product begins, a total rate of increase of 40 to 50 percent is expected, and 70 to 80 percent of this will be Japanese products.

The reasons for this trend include the aforementioned miniaturization of equipment and the strong demand for reduced power dissipation in memory devices. For this purpose, the power dissipated during storage need not be as low as that during battery backup. However, it will be necessary to bring cost and speed close to that of the n-MOS static RAM. The target for cost is no more than 1.3 times the cost of the n-MOS static device. The present 4 K product is 1.3 to 1.5 times that, or close to the goal. The speed of the 16 K product has caught up with the n-MOS.

The applications with battery backup will also grow. One reason for this is improvements in batteries. The operating temperature range, reliability, and capacity are being improved. Development is being carried out to reduce power dissipation in the CMOS device during standby, and products have appeared with self-discharging current equal to that of batteries. Also, lithium batteries have come into use.

From 4 K to 16 K

IC manufacturers have also made an effort to develop CMOS devices. In particular, applications involving batteries are flourishing. In Japan, miniaturization of machines is very important, so most manufacturers are working on this. The recent policy of most manufacturers is to make a complete line of products rather than mass-producing a particular kind of memory device. The CMOS RAM is one of the most important. Most of the large-scale integrated devices of the future will probably be CMOS devices because of restraints on power dissipation.

The main product at present is the 4 K RAM. The first of these appeared in 1977. Some samples of the 16 K product began to come out at the end of 1979. Many manufacturers got involved during the latter part of 1980 and 1981. The present is a startup period for this product. Toshiba Corporation and Hitachi Ltd are already producing between several tens of thousands and more than 100 thousand units per month (the Hitachi product uses CMOS for only the on-chip-peripheral circuitry; n-MOS with high-resistance load is used for the cell). Nihon Electric Company, Fujitsu, and Oki Electric will soon move into mass production. The goal is 100,000 units per month by this fall. The Harris Corporation of the United States will put out samples this summer and Mitsubishi Electric will do the same this fall.

These 16 K products are completely different from the previous 4 K product. Also, the aim of the 16 K product differs according to the manufacturer. The unit cost for a complete CMOS device (with CMOS memory cells) is about 3,000 yen when purchased in quantity. This is five times the cost of the 4 K CMOS and 1.5-2 times that of the 16 K n-MOS. Below we will compare the function, performance, and application technology of the various products.

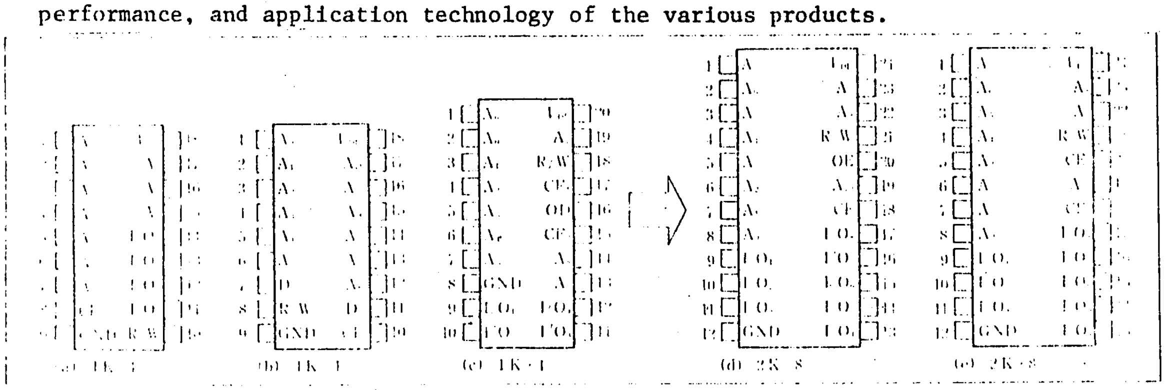

Figure 1. Pin configuration of 16 K CMOS RAM. There is a pin configuration similar to that of the n-MOS static RAM (d) and one that is oriented to battery backup (e). One type of (e) goes into a very low-power dissipation standby mode only when $\overline{CE}_2$ is at a high level. There are other types that go into a standby mode at either $\overline{CE}_1$ or $\overline{CE}_2$.

24 Pins, High-Speed Operation in All Devices

In Table 1, the 16 K CMOS RAM product lines are compared. The memory structure is 2 K words x 8 bits. The 4 K product has a 1 K by 1 bit and a 4 K by 1 bit array. All use a standard 24-pin DIP package. The 4 K product had either 18 pins and 20 pins. The pin configuration is a standard form of byte-array memory which is compatible with 16 K EPROM's (see Figure 1). However, there are three types of chip selection terminal which choose the needed product type according to use.

Looking at function, we see that access time has gotten faster. It is now about 120 to 250 nanoseconds, about the same as the n-MOS, compared to 500 nanoseconds in conventional products. This is a result of miniaturization of pattern dimensions. The peripheral circuitry on the chip has been made faster by manufacturers with the objective of replacing the n-MOS device. As a result, products have appeared in which the current consumption in active mode is much greater than that of the n-MOS. In some products this has been lowered by manipulation of the circuitry. In contrast to the 4 K device, most of these are perfectly static (only one company produces a synchronous model). There is a varying range of current consumption during standby depending on the manufacturer. Some products bring out the special features of CMOS and keep the power consumption at 1 nanoampere at normal temperature, while others are halfway between the CMOS and n-MOS. This depends on the purpose of the product. With a power source voltage of 5 volts ±10 percent, data can be stored even when the voltage is as low as 2 volts. Also, there are products with a greater range of operating temperature. These are for outdoor applications such as automatic vending machines. The above figures are all taken from data sheets. The focus of concern, however, is on the actual figures for current consumption during standby and minimum activating power source voltage, as well as for noise resistance and reliability.

Three Types of Chip Selection

From the point of view of function, there are two main types of 16 K devices. The two pin configurations shown in Figure 1 correspond to these two types. The difference is seen in pin No 18 and pin No 20. In Figure 1(d), these pins are the chip-enable $\overline{CE}$ and the output-enable $\overline{OE}$. In Figure 1(e), they are both chip-enable pins, $\overline{CE}_1$ and $\overline{CE}_2$; (d) is an extension of (a) and (b) while (e) is an extension of (c). The configuration of (a), (b), and (d) is the same as that of the n-MOS static RAM. It aims at replacing the n-MOS. When $\overline{CE}$ is at a high level, the device goes into the low-power dissipation standby mode (or the data storage mode). $\overline{OE}$ controls output. When it is at a high level, output enters a high impedance mode and data is not released. In this way, output conflict in the bus is avoided.

On the other hand, (c) and (e) are suited for battery backup applications. This is because the gate can be eliminated by controlling $\overline{CE}_1$ and $\overline{CE}_2$ as shown in Figure 2. $\overline{CE}_1$ is used for chip selection. $\overline{CE}_2$ puts all chips into the low-power dissipation standby mode. This is done simply by applying the high-level memory-save signal MS to $\overline{CE}_2$. Conventionally, it was ideal to have four control signals: $\overline{CE}_1$, $\overline{CE}_2$, $\overline{OE}$, and R/W (read/write). However, because of restraints on

Table 1. Examples of the 2 K by 8 bit CMOS RAM showing representative characteristics. Common characteristics are as follows: power source voltage range Vcc = 5 V ±10 percent; data storage voltage: 2.0 to 5.5 V (excluding HM6116P); package: standard 24-pin DIP. There are some differences between companies in input level voltage range, input leakage current, and input capacitance. A blank space indicates that data is not available.

Product number	Address access time (max.) (ns)	Current consumption (max.) Active*1 (condition)	Current consumption (max.) Standby*2 (condition)	Control Method	Operating temp. range(°C)	Chip size (mm)	Manufacturer
MB8416	200 (200 from $\overline{CE}$ 100 from $\overline{OE}$)	60mA	10μ A ($\overline{CE}$ = Vcc~ Vcc±0.2V)	$\overline{CE}$,$\overline{OE}$	-40~+85	5.18x5.66	Fujitsu
MB8417	200 (100 from $\overline{CE}_1$ 200 from $\overline{CE}_2$)	60mA	10μA ($\overline{CE}_2$ = Vcc~ Vcc±0.2V)	$\overline{CE}_1$,$\overline{CE}_2$	-40~+85	5.18x5.66	Fujitsu
MB8418	200 (200 from $\overline{CE}_1$/$\overline{CE}_2$)	60mA	10μA ($\overline{CE}_1$/$\overline{CE}_2$=Vcc~ Vcc±0.2V)	$\overline{CE}_1$, $\overline{CE}_2$	-40~+85	5.18x5.66	Fujitsu
HM-6516-9/ -2*3	250 (240 from $\overline{CE}$ 100 from $\overline{OE}$ (cycle minimum 390)*4)	10mA f=1Mhz, output 0mA; input Vcc or 0V	500μA ($\overline{CE}$=Vcc~VCC±0.3V, input=Vcc or 0V, Vcc=2V, output 0mA)	$\overline{CE}$,$\overline{OE}$	-40~+85/ -55~+125	--	Harris
HM6116P-2 -3/-4 /HM6116LP-2 -3/-4*5	120/150/200 (120/150/200 from $\overline{CE}$ 80/100/120 from $\overline{OE}$)	80/70/70mA // 70/60/60mA	2mA// 100μA*11,*12 ($\overline{CE}$≥Vcc-0.2V, input≥Vcc-0.2V or input≤0.2V)	$\overline{CE}$,$\overline{OE}$	0 ~ +70	4.76x5.5	Hitachi
HM6117LP-3/ -4*5	150/200 (150/200 from $\overline{CE}_1$,$\overline{CE}_2$)	70mA	100μA*11,13 ($\overline{CE}_1$≥Vcc-0.2V, input≥Vcc-0.2V or ≤0.2V, or $\overline{CE}_2$≥ Vcc-0.2V)	$\overline{CE}_1$,$\overline{CE}_2$	0 ~ +70	4.76x5.5	Hitachi
M5M5116P/-12/ -15*6	200/120/150 (200/120/150 from $\overline{CE}_1$,$\overline{CE}_2$)	50mA	50μA ($\overline{CE}_2$≥Vcc-02V, or input at $\overline{CE}_1$≥Vcc- 0.2V is fixed close to Vcc or 0 V)	$\overline{CE}_1$,$\overline{CE}_2$	0 ~+70	4.8x6.48	Mitsubishi
μPD446C/D-3/ -2	150/200 (150/200 from $\overline{CE}$ 75/100 from $\overline{OE}$)	38mA/30mA	100μA*11,7 ($\overline{CE}$=Vcc)	$\overline{CE}$,$\overline{OE}$	0 ~+70	5.84x6.38	NEC
μPD447C/D-3/ -2	150/200 (75/100 from $\overline{CE}_1$ 150/200 from $\overline{CE}_2$)	38mA/30mA	100μA*11,7 ($\overline{CE}_2$=Vcc)	$\overline{CE}_1$,$\overline{CE}_2$	0 ~+70	5.84x6.38	NEC
μPD449C/D	200 (200 from $\overline{CE}_1$, $\overline{CE}_2$)	30mA	100μA*11,7 ($\overline{CE}_1$,$\overline{CE}_2$,=Vcc)	$\overline{CE}_1$,$\overline{CE}_2$	0 ~+70	5.84x6.38	NEC
MSM5128-12/ -15 -20	120/150/200 (120/150/200 from $\overline{CE}$ 80/100/150 from $\overline{OE}$)	67/62/57mA	50μA*8 ($\overline{CE}$=Vcc-0.2V,input ≤0.2V or≥Vcc-0.2V)	$\overline{CE}$,$\overline{OE}$*9	-30~+85	5.65x6.57	Oki
TC5516AP/APL	250*10 (100 from $\overline{CE}_1$ 250 from $\overline{CE}_2$)	70mA*10	30μA/0.2μA at 25°C, 1.0μA at 60°C*10 ($\overline{CE}_2$=V_{DD}-0.5V)	$\overline{CE}_1$,$\overline{CE}_2$	-30~+85	5.06x5.77	Toshiba
TC5517AP/APL	250*10 (250 from $\overline{CE}$ 100 from $\overline{CE}$)	70mA*10	30μA/0.2μA at 25°C 1.0μA at 60°C*10 ($\overline{CE}$=V_{DD}-0.5V)	$\overline{CE}$,$\overline{OE}$	-30~+85	5.06x5.77	Toshiba

(see notes following page)

[Notes to Table 1]

*1. Unless specified, conditions are: shortest cycle time, duty 100 percent, output 0mA.
*2. Unless specified all operating temperature ranges are given for Vcc=2.0~5.5V during standby or out of input mode. Chip selection symbols are standardized as shown above.
*3. Scheduled for sample shipment in summer 1981.
*4. Synchronous; all other products are asynchronous.
*5. n-MOS memory cell with high-resistance load, only on-chip peripheral circuitry is CMOS.
*6. Scheduled for sample shipment in fall 1981.
*7. 10μA when Vcc=3V.
*8. 20μA when Vcc=2V.
*9. Can respond to demand of CE_1, CE_2
*10. TC5517BP and 5518BP also being readied with 200ns 25mW (standard), and 0.25μW (standard).
*11. When Vcc=5V±10 percent.
*12. 50μA when Vcc=3V.
*13. 30μA when Vcc=3V.

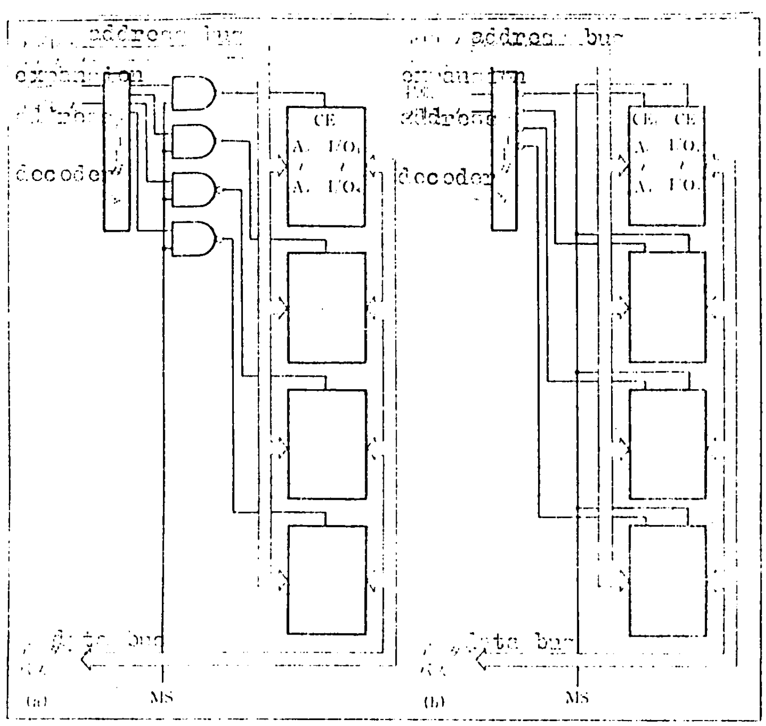

Figure 2. The $\overline{CE_1}$ and $\overline{CE_2}$ Control System Eliminates the Gate when Battery Backup Is Used. (From reference materials prepared by NEC)

the number of pins, not all of these can be used. In the 4 K device, at present, 18-pin configurations (a) and (b) are standard. For $\overline{CE_1}$ and CE_2 control, 20-pin configuration (c) is used. In 16 K devices, this difference was eliminated. With 16 K bits, $\overline{CE_2}$ becomes a negative-logic circuit. It has the advantages of being readily compatible with TTL and being resistant to noise during data storage (more explanation later). However, manufacturers say that both types are suitable in practice.

There are two specific types of control of $\overline{CE_1}$ and $\overline{CE_2}$: the type in which low-power dissipation standby mode is entered only when $\overline{CE_2}$ is at a high level, and the type in which low-power dissipation mode occurs when either $\overline{CE_1}$ or $\overline{CE_2}$ is at a high level. The latter type is best for a large system where the chip is placed in a matrix and decoded. All chips but the one selected are put into a low-power dissipation mode. In the former case, there is no drop in the power dissipation of a single line of chips in the semi-selective mode, where $\overline{CE_1}$ is high level and $\overline{CE_2}$ is low. However, in this case, the access time from $\overline{CE_1}$ becomes very short. In the type of control where low-power dissipation occurs when both $\overline{CE_1}$ and $\overline{CE_2}$ are at a high level, the access time from both inputs is the same. The selection depends on whether priority is given to power dissipation or speed.

Products which enter low-power dissipation mode when only the chip-enable input is held at high level have been produced as 16 K devices and the number produced has risen. The internal circuitry is designed so that other input gates will be cut off when there is input at $\overline{CE_2}$. Originally, 1 K devices were designed this way. But with 4 K devices, devices without this feature appeared. The address and data must be fixed close to power source voltage V_{DD} or 0V. Even with 16 K devices, some models of this type remain (see conditions for current consumed during standby in Table 1). In this case, feedthrough current flows at the input stage in response to medium-level input.

Most manufacturers have prepared devices of both types (d) and (e) shown in Figure 1.

Concern With Actual Pattern of Current Consumed During Standby

Performance requirements for the CMOS RAM are generally rigorous. It must have a wide range of operating temperatures and power source voltages and be highly resistant to noise. The user requirements for the properties shown in Table 1 are stringent. They emphasize actual performance figures rather than maximum values. This is an example of good current consumption during standby. When used with nonvolatile memory, some users demand as low as 1 microampere at normal temperature. In general, the actual values are one order of magnitude lower than the maximum values on the data sheet and one more order of magnitude lower than that at normal temperature. Figure 3 is a graph showing the distribution for approximately 1,000 TC5516APL devices which appear in Table 1. The peak values of the actual devices were under 10 nanoamperes. This value cannot be measured with a conventional tester. This current is highly dependent on temperature. In nonvolatile memory applications, the proper temperature level is said to be 25±10°C. That is because the self-discharging current of the battery is much larger than the CMOS memory current at high temperatures. When used in

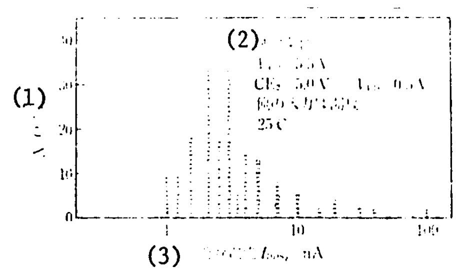

Figure 3. Actual Current Consumed During Standby (in the TC5516APL)

Key:
(1) N (devices)
(2) Test conditions: V_{pp} = 5.5V
CE_2 = 5.0 V (=Vpp-0.5 V)
other inputs open
25°C
(3) Current consumed I_{pps2} (nA)

a large-capacity memory system, the necessary battery capacity becomes extremely large if the device is designed for maximum current consumption. Some users make demands for the average values and dispersion of this current distribution.

The practical values of the power source voltage range are also a matter of concern. In active mode, the nominal value is 5 volts ±10 percent. However, there are many products which operate at around 2 volts. In such cases, however, access time increases. The voltage range where data storage is possible is given as 2.0 to 5.5 volts on the data sheet. Actually, it is reported that storage can take place at voltages as low as 1.5 volts. Such a figure means faulty operation.

Resistance to Latch-Up

Latch-up is a particular problem of CMOS. This is a phenomenon which occurs when the parasitic thyristor in the CMOS structure conducts because of external noise and large amounts of short-circuit current continue to flow until the power source is cut off. The 1 K devices were susceptible to input noise. The cause of this was the diffusion resistance applied to input to prevent electrostatic breakdown. Forward current flowed in the pn junction (parasitic diode) of the resistor, triggering the parasitic thyristor. There were also some 4 K devices in which diffusion resistance was used initially. At present, polysilicon resistance is used, so latch-up does not occur except in the parasitic diode. Since resistance cannot be applied to the output circuit, the circuit pattern must be manipulated to increase resistance to latch-up. Manufacturers' know-how is also applied to such matters as the spacing of the p-MOS and n-MOS transistors, the manner of inserting guard rings, the depth of the p well, the density of impurities, and techniques of equalizing the substrate potential and source potential.

Noise During Data Storage a Source of Trouble

How to deal with noise when the CMOS RAM is put into low-power dissipation standby mode during data storage is a difficult problem. Recent products have high-speed response, so when noise in thin whisker-shaped pulses is applied, errors may occur in reading and writing. Tateishi Electric investigated actual examples of this and techniques for dealing with it in 4 K devices.[2] In its investigation, the cause was found to be noise due to static electricity. In Figure 4(a), when the power source voltage drops, CE_2 goes to a low level and the memory enters the data storage mode. If noise pulses are applied to the CE_2 line at this time, the CE_2 level is pulled up and this causes faulty operation. If fine noise pulses are continously applied, a direct current component occurs between the capacitor C_1 terminals, and the C_2 level is pulled up. To eliminate this direct current level, a diode was used as shown in Figure 4(b). This circuit is not perfect but has been reported to be effective in practice.

Among the products used were some which were particularly susceptible to the influence of static electricity. This characteristic was concentrated in a particular production lot from a certain company. The voltage of static electricity which causes faulty operation is one order of magnitude lower than that of other products. Faulty operation occurs with a finer pulse and at a lower level than that of other lots. The more these kinds of lots appear and the greater the dispersion of properties between lots, the greater the problem. Also, it is desirable for the chip-enable input to be negative logic. That is because the margin of the input level is narrow on the low-level side. The 16 K devices are made with negative logic. Some manufacturers, as a consequence of achieving greater speed, have reduced the size of the minimum write-pulse width. In response, an attempt is being made to increase the minimum write-pulse width. The analysis of noise properties, including latch-up, is difficult.

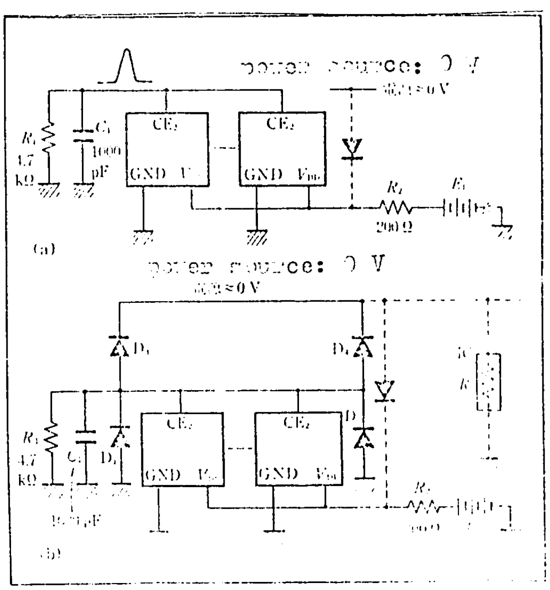

Figure 4. When noise is applied to CE_2 during data storage, read-write errors may occur: (a). Prevention circuit: (b)

Timing requires caution in active mode as well. The products shown in Table 1 are mostly completely static (asynchronous). However, there is actually a correlation between the address and control input, and improper timing can cause writing errors.

Problems have existed with respect to reliability. The current consumed during data storage sometimes increased abnormally, causing faulty operation; for example, reduced voltage in the backup batteries. Also, corrosion sometimes occurred in the Al wiring. The former was a result of residual contamination. The latter was due to a problem with the protective film on the chip surface.

Production Technology Differs With the Manufacturer

The production technology used by different companies reflects their differing objectives. Toshiba and Hitachi have contrasting approaches. A concept accepted by Toshiba and many other companies is that 2 K by 8 bit MOS static RAM's are divided into two types--the fast, low-cost n-MOS and the medium-speed, low-power-dissipation CMOS--and there is no intermediate relationship between them. With this approach, it is necessary to lower the current consumption during standby as much as possible in order to bring out the special features of the CMOS RAM. In contrast to this, Hitachi has taken the policy of supplying one product with applications of both n-MOS and CMOS. CMOS is used for the on-chip peripheral circuitry, and a type of n-MOS with high-resistance load is used for the memory cell array which takes up most of the chip surface area.[3] Current consumption is lower than that of a perfect CMOS RAM.

In order to keep the current consumed during standby in the nanoampere range, it is necessary to use a six-transistor CMOS cell. The current is determined by the MOS transistor cutoff current (subthreshold current) and the pn junction leakage current. In order to obtain the properties given in Figure 3, Toshiba particularly lowered the leakage current. In order to do this, it eliminated certain wafer defects, for example, defects which occur during formation of the field oxide film, and heavy metal contamination which occurs during p-well fabrication. The key in this is the point in the fabrication process where heat treatment and gettering are performed.

The design rules are to shrink the RAM from the 6 to 7 micrometers of the 1 K product to 5 micrometers for the 4 K product and 3 micrometers for the 16 K product. While a perfect CMOS may be as small as 2.5 to 3.5 micrometers, the Hitachi CMOS/n-MOS will be 3 to 4 micrometers, a little slack. Toshiba uses a 10:1 projection exposure apparatus. In order to hold down the expansion of chip surface area without using this exposure apparatus, NEC is using dual-level polysilicon and Mitsubishi is using dual-level aluminum interconnections.

In a conventional CMOS structure, a p well is formed in an n substrate and p-MOS is fabricated on the n substrate and n-MOS in the p well. Hitachi forms a p well and an n well in a high-resistance substrate and places a large n-MOS cell array inside the large p well. By this means, high speed can be achieved along with resistance to alpha-ray soft errors. Mitsubishi uses an n well in a p substrate. The same process as that for the high-speed n-MOS can be used.

As shown in Table 1, when a CMOS RAM becomes faster, the power dissipation during active power increases. In order to reduce this, NEC uses the method of internal dynamic activation.[4] A sense amp and clocked control of the bit-line load are particularly effective. An example of bit-line load is shown in Figure 5. When clocked control is not used, if the word line rises and the cell transfer gate opens, a direct current path occurs as shown in the figure. This affects the entire cell connected to the word line. This is very serious with an increased number of bit lines and chips. To prevent this, the bit-line load must be cut off when the word line rises, as in Figure 5. The internal control clock activates during address change. Toshiba uses the same concept in its 4 bit product, the TC5514AP. The plan is to use it in the 16 K product as well (BP version).

Another possible technique for achieving high speed is to reproduce signals midway on the word line (Hitachi and NEC).

Aiming at the Field of High Speed

Hitachi is aiming for high speed with the aforementioned CMOS/n-MOS technology. Its first product was a 4 K RAM with a maximum access time of 55 ns/70ns. This January, Hitachi put out a sample of a 16 K by 1 bit RAM, the HM6167, which has access times of 70 ns/85 ns/100 ns. The power dissipation is markedly lower than that of the n-MOS. It is housed in a standard 20-pin DIP package 7.6 millimeters wide. The surface area is small, 40 percent of the standard 24-pin DIP. Furthermore, samples of a fast version of the 4 K RAM, the HM6147H, are scheduled for shipment this summer.

Intel Corp of the United States will ship samples in the near future of a 4 K by 1 bit RAM with maximum access times of 100 ns/150 ns/200 ns. This is a perfect CMOS using an n well. Another U.S. company, Integrated Device Technology Inc, is selling a 2 K by 8 bit CMOS RAM with a maximum access time of 70 ns/90 ns/120 ns.

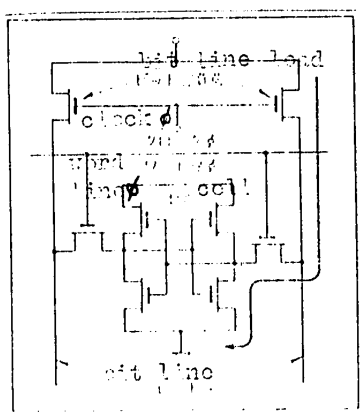

Figure 5. Active current is restrained by internal clocked control. This is an example of bit-line load control. When the word-line potential rises, the bit-line load is turned off by clock ϕ and the direct current path shown in the figure is cut off. A sense amp also provides clocked control.

A 64 K CMOS RAM By 1983

When the move is made from a 16 K to a 64 K product, production of pure n-MOS static RAM's will probably be reduced. Because of power dissipation restraints, the peripheral circuitry will have to be CMOS. CMOS/n-MOS and pure CMOS technology will be used. Manufacturers will probably split into those who are making both types and those who make only one. In the area of technology, an n-well device which has many fabrication processes in common with n-MOS is attracting notice. With respect to this, some observers say that the pure CMOS with an n well will have problems with power dissipation during standby, and the CMOS/n-MOS combination will have trouble with alpha waves and input undershoot. As miniaturization proceeds, both the n-MOS and p-MOS will reach the optimum structure for independence. Samples will be put out during 1981 at the earliest. Most observers believe that mass production will take place from 1983 on. (Rikiya Okabe)

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SCIENCE AND TECHNOLOGY

SECRETS TO SUCCESS OF JAPAN'S AUTO INDUSTRY

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 23, 24, 25, 26 Jun 81

[Four-part article by Hiroshi Nonaka, NIKKAN KOGYA reporter]

[23 Jun 81 p 8]

[Text] Rising World Appraisal

The 1980's are said to constitute an era of global auto warfare. The joining of hands (joint ventures) among automakers of the United States, Europe, and Japan could be seen as efforts to "survive" in this war. Nonetheless, technological capability is the basis for survival. General Motors, the king of the world's carmakers, has invested the enormous sum of 40 billion dollars in research and development funds for the 1980-84 period toward the development of new-model cars, because it believes that "technology is the decisive factor." During the past several years, Japanese cars have won a universal reputation as the "world's top-level cars." But can they maintain this superiority? Also, what are the factors that go to make up this superiority? I will take a look at these questions. (Reporter Hiroshi Nonaka)

In February of this year, Nissan Motors announced in the Japanese newspapers that it had developed the "E"-model engine. A week later, the company received a technical inquiry from the Ford Company of the United States. "We have never had such a speedy response. It probably indicates the degree of interest in Japanese auto technology among foreign carmakers. Nonetheless, we are amazed to receive such attention after only a week." Managing Director Jiro Tanaka, who is Nissan's director of technology, had a sardonic smile as he spoke.

One does not need to cite the "E"-model engine as an example to emphasize the speed with which news concerning Japanese technology and new models developed by Japan's carmakers travel around the world today. According to MOTOR MAGAZINE, a major motor trade magazine: "Until four or five years ago, news concerning Japanese car model changes were carried in the world's trade publications a year or so later. Moreover, no mention was made regarding the engines and components. Recently, practically every motor trade magazine has been carrying news about the new Japanese models as soon as they are announced. This is indicative of the interest abroad in Japanese cars." (Hajime Kaida)

Japanese cars and Japan's auto technology are widely introduced throughout the world, and a great mass of users are waiting out there. Consequently, "proud" foreign manufacturers cannot help but focus attention on Japanese auto technology. In this sense, the technical cooperation agreement signed in January this year between Daihatsu Kogyo and Inocenti Company of Italy could be considered a case that underscores the high level of Japan's engine technology.

The agreement calls for an annual export shipment by Daihatsu to Inocenti of 20,000 engines to be used in the compact passenger car "Charade." (1000-cc engine, 3 cylinders) Approval was granted by the Italian Government in late May, and [the shipment] is scheduled for loading soon. Daihatsu Kogyo has suddenly begun to attract attention from the world's carmakers, including an agreement signed last fall to export 100-200 "Charade" engines annually to Auto Mekanika, a new Greek automaker.

With regard to the blitz announcement last summer of a Toyota-Ford partnership, Ford Company reportedly is strongly interested in the technology of Toyota's subcompacts, especially the "Corolla" model. In the background is Ford's interest in the technology of Daihatsu Kogyo, a partner of Toyota Motors. The Daihatsu people admit that "Ford representatives made three visits to Japan between late 1979 and late 1980, meeting with President Sakae Ohara and other Daihatsu officials." The feasibility of providing technology is said to have been the center of discussion, but it did not materialize because of Daihatsu's refusal.

However, as a result of the visits to Japan, Ford succeeded in obtaining technical cooperation concerning Toyota's "one box wagon car." This has become an era of "technical assistance to troubled American carmakers." (Toyota President Eiji Toyoda, at a press conference at Narita Airport immediately following announcement of the Toyota-Ford partnership on 20 July last year)

The provision of technical cooperation by Japanese automakers is not limited to the United States. The provision of production techniques and a complete set of facilities by Honda to the established British manufacturer British Leland (an agreement was signed in December 1979 on the subcompact passenger car "Ballad,") is well known. Also, Nissan Motors is providing the prominent European car manufacturer Citroen of France with techniques to cope with gas exhaust problems. In January 1980, Citroen, which had been unable to meet exhaust pollution standards in Japan--the strictest in the world--requested Nissan's cooperation concerning catalytic technology to be applied to its cars for export to Japan, and it succeeded in obtaining an agreement. However, this fact is not known to the general public. The reason is that "proud" Citroen feared a decline in its image if it became known that it had received technical assistance.

Details of the Nissan-Citroen agreement on technical cooperation are therefore unclear. But such cases are not rare in today's auto industry. Requests for technical cooperation continue to pour in from Europe, the United States, Eastern Europe, and the Soviet Union. But it is questionable whether they will be made public in case they do materialize. An official in charge of technology for a Tokyo automaker, conducting negotiations on technical cooperation with a leading European manufacturer, says, "Our company would like to publicize it widely. But the European manufacturer in a reputedly leading car-producing nation is strongly "against publicizing any introduction of foreign technical assitance, and has included a clause in the agreement forbidding any publicity."

The world's carmakers are joining hands in many forms in order to survive in the war of compact cars in the 1980's. Technical negotiations are part of the phenomenon. Consequently, many negotiations tend to be held in secret.

One thing which could be stated with certainty is that during the past several years, Japan's auto technology has suddenly become the center of world attention. Since when? Why? Clarification of these questions would indicate the future trend of Japan's auto industry.

[24 Jun 81 p 9]

[Text] Improved Durability and Reliability

Toyota Motors has "matured" to the point where it is now providing Ford, the world's second largest automaker, with auto production techniques. But it started out by "copying Ford." (Managing Director Masatoshi Morita) A copy cannot be better than the original. Naturally, various problems were encountered. Between 1945 and the mid-1950's, the most frequent problems experienced by not only Toyota but all of Japan's carmakers were "breakdowns."

In those days, Japan's roads were extremely inferior and the percentage of paved roads was low. In addition to the imperfect auto technology, the bumpy roads naturally resulted in frequent breakdowns. Ironically, however, the bad roads contributed to the drastic improvement in the durability of Japanese cars, and this became an important factor in producing the world's finest, "breakdown-free" cars.

Managing Director Masatoshi Morita of Toyota Motors and Managing Director Jiro Tanaka of Nissan Motors, technical directors of Japan's top two carmakers, agree: "The taxis which traveled on bumpy roads performed the role of test drivers and gave us the incentive to improve the performance and durability of our cars." Until the mid-1950's there were few owner-drivers, and the majority of the cars in demand were taxis. The taxis traveled on unpaved roads like "kamikaze taxis," somewhat like the road races held in the mountainous regions of Africa. Just as the road races tested the performance and durability of cars under severe conditions, the taxis of the mid-1950's provided a number of important "data" to auto production experts. This has culminated in the subsequent leap in car quality and performance.

This year's April issue of the popular West German weekly magazine FUNK UHR L carried a special article entitled, "Which is superior, the Japanese car or the German Car?" To compare its own cars with Japanese cars is itself unusual in Europe, and indicates the rising evaluation of Japanese cars. What is especially noteworthy is the high praise expressed in the article: "Japanese cars are highly reliable, but the Toyota is especially good." It thus rates them higher than their own Mercedes Benz, Opel, and Audi.

Data obtained by the West German car inspection (TUV) in 1980 also clearly show the high reliability of Japanese cars. The West German inspection checked out 26 items: 8 items on the chassis, 10 items on the brake system, 5 items on lighting, 2 items on exhaust pollution and noise, and 1 item on riding comfort. The results of the inspection are provided in terms of an average fault rate (average for all model cars in an inspection year), and the superiority of a car is based on how low its fault rate [is].

According to the results, the West German Mercedes Benz had the lowest fault rate, with 3 out of 28 items. Next were Nissan (4 items) and Toyota (5 items), followed by Toyo Kogyo, Mitsubishi, and Honda--all Japanese makes. Following them were West German models other than Mercedes Benz, a Swedish model (Volvo), the French models Peugeot and Renault, and the Italian Fiat.

It is ironic that the inspection results for France and Italy, which severely restrict Japanese imports, were inferior. Peugeot and Renault had a fault rate four times that of the Japanese makes, which have the lowest fault rates. In the case of Fiat, it was even worse.

One benchmark for car reliability is the marketability of used cars. This is because the value of cars that have fewer breakdowns and greater durability does not decline. According to a user poll conducted by the West German motor trade magazine MOT in October (1 Oct 80 issue), used car prices for the Mercedes Benz and BMW are high, followed by such Japanese makes as the Honda, Mitsubishi, Toyota, and Nissan models. Here again, Italian and French car prices are generally low. "Japanese cars have established a reputation for few critical defects, even as used cars." (MOTOR MAGAZINE president Hajime Kaida)

Only some 20 years ago, Japanese cars had a low reputation abroad for reliability because of frequent troubles. But today their defects are caught immediately, and major breakdowns are prevented through a driver training control system and a diagnostic system which accurately pinpoints the trouble. There are now practically no cases where a driver is compelled to abandon his car on the road and walk home on foot.

Additionally, Japanese car production technicians, who seek greater perfection, are aiming for the "Feller mode analysis." (Shinji Seki, managing director of Mitsubishi Motors) "Feller mode analysis" is a technical method devised by the U.S. National Aeronautical and Space Agency (NASA) in implementing the Apollo space project. It is applied in order to "anticipate the occurrence of technical trouble, and to perform checks and doublechecks in order to prevent their occurrence."

[25 Jun 81 p 9]

[Text] Fuel-Efficient, Low-Pollution Cars

Late last October, the U.S. Environmental Protection Agency (EPA) announced its initial list of fuel-efficiency standards for 1981 model cars (put on sale in October 1980) sold in America. According to the list, the Toyota "Starlet" and Mitsubishi "Mirage" had the highest fuel efficiency rating among 1300-1600-cc engine models. They were followed by the Nissan "Sunny," Toyota "Tercel," and

Toyo Kogyo "Familia." The Japanese makes were far ahead of such compacts as the General Motors "Chevette" and Ford "Escort."

Of course, the 1300-cc Starlet and 1400-cc Mirage cannot be compared on the same basis with the 1600-cc Chevette and Escort. Still, the Chevette and Escort do not have better fuel efficiency than such "top-grade cars" as the 1800-cc Corolla (Toyota) or the 2000-cc Violet (Nissan). The EPA list clearly shows the outstanding fuel efficiency of Japanese cars.

The results of "test driving" by taxis in the late 1950's bore fruit in the late 1960's, and Japanese cars began to gain a high reputation for reliability. However, "it has only been in the past two or three years that they have begun to be viewed as superior cars at home and abroad." (Sadao Kobayashi, executive director of Mitsubishi Motors)

The improved reliability of Japanese cars was as yet insufficient as a barometer for evaluation. From that point on, however, world appraisal of Japanese cars changed rapidly, and they began to be regarded as "outstanding cars." What were the factors? What was added to their reliability? Regarding the reasons for their climb to superiority both in reputation and substance, Japanese auto experts say, "This cannot be discussed without considering antipollution measures." (Kiyoshi Matsumoto, executive director of Toyota Motors)

In December 1976, the Japan Environmental Protection Agency issued the antipollution control act for automobiles (enforced in FY 78) despite fierce protests by the auto industry. Dubbed the "Japanese Muskie Act," it was actually much more restrictive than the Muskie Act. Even today, automakers do not hide their resentment toward its severity. In reality, the investment necessary for development in order to pass the strict standards brought an added burden to the automakers and resulted in higher car prices and increased costs to the consumer. Moreover, the fuel efficiency and horsepower of cars immediately following the enforcement of controls were not very satisfactory.

Nonetheless, the reason that "the development of Japanese cars cannot be discussed without considering antipollution measures" is because the strict controls helped to accelerate research and development on engine combustion technology and were instrumental in its progress. In general, the decrease in NOX (nitrogen oxide) and hydrocarbons are a tradeoff for fuel efficiency. An increase in the compression ratio of a reciprocating engine boosts its power and results in better fuel efficiency. But the temperature also rises and increases the amount of NOX exhaust. Conversely, a lower compression ratio results in less power and lower fuel efficiency.

"A drop on one side of the equation results in a rise on the other side." The keys to solving the tradeoff relationship were improved engine combustion technology and the development of catalysis technology. The Honda CVCC-II, the Nissan 2-plug rapid combustion, and the Mitsubishi MCA jet technologies are highly evaluated throughout the world as improved engine technologies. Also, such leading combustion techniques as the rarified combustion method used in the light Toyota engine, the whirlpool combustion method using the modified intake port adopted by various manufacturers, and the establishment of the electronic-control fuel injection method were successively developed between 1975 and 1980.

Meanwhile, research and development on catalytic technology, which played a key role in antipollution measures, came to fruition, and it became possible simultaneously to eliminate the three elements of NOX, hydrocarbon, and carbon dioxide (ternary catalysis). The advent of ternary catalysis meant the attainment of low pollution without depending on combustion technology. It was thus possible to divert research from that area of engine combustion technology to fuel efficiency and boost in power, resulting in the world's most fuel-efficient, pollution-free cars.

Realization of low-pollution, fuel-efficient cars through advanced engine combustion technology and catalytic development was an epoch-making event in Japanese auto manufacturing. Managing Director Masatoshi Morita of Toyota Motors said in retrospect, regarding the improvement in combustion technology and development of catalytic technology, "It was the first drastic reform in the history of Japan's auto industry."

The unfavorable environment of unpaved roads in the mid-1950's played a role in sharply improving the durability and reliability of Japanese cars, and the world's strictest antipollution standards in the mid-1970's sparked the creation of fuel-efficient, low-pollution cars. It could be said that these minus factors, nonexistent in other countries, were converted to the plus side. In that sense, Japan's top level auto technology could be said to have been "born from an adverse environment and from a persevering national character which was able to overcome that environment." (Junichi Orino, vice president of Daihatsu Kogyo)

[26 Jun 81 p 7]

[Text] Improved Engine Performance

The Ogikubo business office of Nissan Motors is located in a quiet residential district of Momoi, Suginami Ward, Tokyo Prefecture. In December 1977, a project team was formed there. This was the beginning of the "new engine development project" headed by Fujihiko Deguchi, deputy director of the second engine design division.

Soon after the project team was formed, three points were established as basic guidelines for new engine development: 1) reduce the engine weight; 2) improve the fuel efficiency; 3) reduce friction. The objectives of new engine development were higher performance and fuel efficiency, based on the premise of a global auto war in the 1980's. Naturally, it would be necessary to apply the most advanced technological standards. The project team had selected the three goals for development as the most urgent tasks from a number of development themes.

The matrix of today's reciprocating engine was the internal combustion engine developed in 1885 by two Germans, Gottlieb Daimler and Karl Benz. Today's reciprocating engine is basically no different from the engine of those days. Thus, "the engine has undergone a succession of modifications and reached the stage where it is difficult to improve it any further." (Sadao Kobayashi, executive director of Mitsubishi Motors) Others hold the extreme view that while "it is impossible to "improve the reciprocating engine any further, it is another matter to develop a totally different engine system." Under such circumstances, the project team prepared detailed designs for the selection of materials for a new engine, for solutions to the problems of noise and pollution resulting from smaller and lighter engines, for changes in the configuration of the combustion chamber, for a decrease in the speed of heat transmission, for the measurement of crankpin friction, etc. In May 1978, prototypes were made; however, it took another two years to put them into practical use.

Takao Noda, of the second engine design division, who was assigned to development, says in retrospect, "There were many cases where we built prototypes according to the designs but failed to achieve the expected results in the tests." For example, the configuration of the intake port designed to accelerate the speed of heat transmission was crucial, and Noda says, "We built six precise configuration models alone. And we made measurements to see how whirlpools could be produced to speed up heat transmission. But the distribution of whirlpools would differ, depending on the air volume. Each time we would have to alter the configuration." This indicates that, despite the major advances in the field of electronics today, basic research can depend only on trial and error.

It was through such trial and error that the "E"-model engine used in the compact "Pulsar" model was built. It is 17 kilograms lighter than the previous 1200-cc engine. It is one of the lightest Japanese engines in its class. Since it is used exclusively in front-wheel-drive cars, it will play a strategic role in cars built for world competition by Nissan Motors, which is planning to convert to front-wheel drive. It is not surprising that "Ford responded immediately to the "E"-model engine." (Managing Director Jiro Tanaka)

Incidentally, the "E"-model engine has another structural feature which could become "epoch-making" in the history of Japanese auto technology. This is the variable cylinder drive system. This is a system which changes the number of cylinders in use while the car is being driven. When starting the engine or when climbing uphill, or when a high torque (power to move the car by engine revolution) is demanded, such as at a speed in excess of 60 kilometers per hour, all cylinders come into use. And at ordinary speeds of 20-50 kilometers per hour, the number of cylinders in use is reduced. It was designed to avoid the use of unnecessary cylinders at certain speeds, and to economize on fuel consumption.

Actually, this system was introduced last fall by General Motors on its Cadillac supercar, and it became a world sensation. Japanese automakers have been working on a similar system as an important theme for more than 10 years. Thus, some technical experts undoubtedly felt that they were "beaten to the draw" when General Motors put its system into practical use.

However, a mere six months later, Nissan Motors--and subsequently Suzuki Motors--succeeded in building similar systems. Nissan's "E"-model engine can shift from 4 cylinders to 2 cylinders at braking speed, or stop all 4 cylinders. Also, Suzuki Motors' "variable cylinder engine" (installed on its light commercial "carry van") can shift instantly at high speed from 2 cylinders to 3 cylinders and vice versa.

With Nissan's variable cylinder conversion limited to braking speed and Suzuki Motors' variable cylinder system focused on a 2-cycle engine, the prevailing view is that "they are still not ready." In any case, they are certainly Japan's first examples in the premature worldwide stage of practical use. Especially, the fact that Suzuki Motors, a minor automaker specializing in light cars, has produced a variable cylinder system indicates the broad range of technological development achieved by Japan's car manufacturers.

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SCIENCE AND TECHNOLOGY

KOMATSU RECEIVES ORDERS FOR PIPE-LAYERS FROM SOVIET UNION

Tokyo NIHON KEIZAI SHIMBUN in Japanese 7 Jul 81 p 1

[Text] It became known on the 6th that Komatsu Works, which is our country's biggest construction machine manufacturer, has received orders for pipe-layers for shipment to the Soviet Union, amounting to 160 million dollars (about 36 billion yen, at the present yen quotation), and that it has already started their shipment. This is a business deal, which the Caterpillar Tractor Corporation of the United States had been negotiating at first with the Soviet Union. However, as Caterpillar Tractor became unable to export them to the Soviet Union because of the U.S. Government's policy of banning exports to the Soviet Union, Komatsu received the orders for them.

In the Soviet Union, the laying of pipelines for oil and natural gas is being carried out in various places, centering on the Siberian region, and demand for pipe-layers is increasing. A pipe-layer is a machine which is something like a bulldozer with a small-size crane attached to its side, and it lifts up the pipe and then lays them, one by one, while the machine moves forward. Caterpillar Tractor and Komatsu are virtually the only companies in the world, which manufacture these pipe-layers, and both companies have actual records of exports to the Soviet Union.

Taking into consideration the delicate international situation surrounding trade with the Soviet Union, Komatsu has not announced the fact of these large-scale business talks. However, there is even the possibility that the business talks for 40-million-dollar worth of pipe-layers, which the Caterpillar Tractor is now pushing with the Soviet Union may also be handed over to Komatsu. The development of the "Yamburg project," which is a project for the laying of natural gas pipeline from the Soviet Union to West Europe, is now being watched with attention, and the moves of Komatsu are also likely to attract attention.

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SCIENCE AND TECHNOLOGY

MORE ACTIVE GOVERNMENT ROLE URGED IN DEVELOPING NATURAL RESOURCES

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 964, 21 Jul 81 p 3

[Text]

Japan Federation of Economic Organizations (Keidanren) has worked out proposals calling for the Government to take more responsibility in securing overseas natural resources, such as non-ferrous metals, oil, coal and lumber for the economic security of Japan.

After six months of study, Keidanren, headed by Yoshihiro Inayama, has come up with various proposals to be submitted to the Government. They will call for the Government to take a more active role in direct negotiations with other governments for developing natural resources abroad.

The proposals will also ask the Government to try to help lessen the investment risk in overseas development of natural resources by private corporations by approving overseas investment insurance for developmental projects with any country.

Keidanren will also ask the Government in the proposals to buy up in principle the domestic stockpiling of natural resources as "the government stockpiling" and abolish the present "repurchase agreement" for non-ferrous metal products.

The proposals were compiled by the Natural Resources Countermeasure Committee of Keidanren, headed by Shinpei Omoto, chairman of Mitsui Mining & Smelting Co., and were accepted by the board of directors of Keidanren late last month.

The natural resources under consideration include oil, coal, non-ferrous metals and lumber — with an emphasis on non-ferrous metals and lumber because of the difficulty in developing these natural resources and their poor business performance resulting from the dull tone of the market.

Keidanren will ask the Government to step up its diplomacy on resources in which governmental agencies will initiate negotiations with other governments to obtain mining concessions abroad.

The Japanese non-ferrous metal industry has increasingly been defeated lately in bidding competition with international major oil companies and U.S. major non-ferrous metal companies.

With many developing countries nationalizing their mining of non-ferrous metal ores, it has become increasingly important for the Japanese Government to negotiate with the governments of these developing countries for opening up new business opportunities for the domestic industry.

Keidanren insists that the Government should set up a system for sharing the developmental risk involved in mining projects by private companies in addition to the cooperation extended by the Metal Mining Agency of Japan in research for resource development.

Keidanren will also request that the Government improve the overseas investment insurance system so that private corporations can avoid risks resulting from their own investment in overseas countries and from fluctuation of the foreign exchange rate.

It will ask the Government, in more specific terms, to allow private enterprises to use the insurance to invest in countries facing political instability.

The overseas investment insurance at present cannot be applied to such countries as Iran, Iraq, Zaire and Papua New Guinea — all of which are abundant in oil, copper and lumber.

Furthermore, Keidanren will request that the Export-Import Bank of Japan extend its loans directly to foreign companies in the form of buyers' credit or bank loans when Japanese non-ferrous metal companies are to carry out a joint developmental project with the foreign companies.

As far as the non-ferrous metal industry is concerned, the Exim Bank, in most cases, gives out its loans to Japanese companies in the form of suppliers' credit system. The Japanese non-ferrous metal industry, consequently, has to take full responsibility for the exchange risk and is currently burdened with $300 million in deficit which is the remainder of loans extended when the dollar was ¥360 at the exchange market.

The domestic non-ferrous metal industry is faced not only with these investment and exchange risks but also with the cost for stockpiling natural resources at home as domestic demand for such resources is rather sluggish.

Although its stockpiling of copper has considerably decreased, the industry is still left with 100,000 tons of zinc. Under the present agreement, the industry is required to repurchase stockpiled resources including interest rates three years after the Government purchased such resources. And Keidanren wants the Government to buy up the stockpiled resources.

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SCIENCE AND TECHNOLOGY

OIL FIRMS FACE SERIOUS FINANCIAL SITUATION; LIABILITIES GAIN SHARPLY

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 964, 21 Jul 81 p 6

[Text]

Oil companies' financial positions have deteriorated rapidly. Many are operating at loss because of twin pressure of slow product oil price hikes and foreign exchange losses (caused by the weak yen in recent months). The situation is so bad that of the 34 companies, 10 will witness their cumulative, carried-over loss surpassing net worth by the middle of fiscal 1981.

Effective July 1, they were curtailing refining of crude oil, while the Ministry of International Trade & Industry is trying to assist the industry by planning price guidelines (as allowed by the Petroleum Industry Law to prevent price nosedive and skyrocketing). Despite these measures, the whole industry finds it difficult to turn its operation into profitable one unless the yen gains strength quickly.

Maruzen Oil Co. is in the most serious problem. The refiner reported ¥28.8 billion in recurring loss, reducing its net asset to only ¥1,925 million at the end of March, 1981. Every month since April, Maruzen has lost an estimated ¥10 billion because of failure to have its ¥7,000 per kiloliter price hike accepted by all users and foreign currency exchange losses.

Maruzen Oil has come up with business rehabilitation measures and will submit them to its related financial institutions late this month.

The measures are slashing the number of its employees by 1,000, such as by recruiting voluntary retirees and sending employees to related firms, reducing costs for crude oil imports by modifying import contracts, selling the Osaka head office building and stocks held, and cutting directors' remunerations.

The company, however, intends to continue operating its four refineries.

Even Nippon Oil Co., the largest in Japan with an access to inexpensive Aramco (Arabian Americal Oil Co.) crude oil, was expected to report nearly ¥20 billion recurring loss for the first half of fiscal 1981. Also in the April-September period, Idemitsu Kosan Co. was likely to report ¥60-80 billion in loss, followed by Mitsubishi Oil Co. with ¥40 billion and Daikyo Oil Co. with ¥25 billion.

A MITI investigation found that 14 major oil companies' combined recurring loss totaled ¥165 billion in the first quarter of this year. Besides the price and usance (foreign exchange) problems, these firms are paying extra for stockpiling. Crude oil imported in recent months is being stockpiled in the bunkers of tankers, which carried the crude oil cargo.

The stockpiling is costing an estimated $1 a barrel a month, making it a new cost problem. The imports were not immediately reduced because contracts had been signed before the 15 per cent refining reduction since July 1.

Oil losses were expected to snowball — if no price hikes are possible and yen continues to be weak against the dollar. Assuming that the exchange rate of the dollar to ¥230 continues through the end of September, the industry will lose ¥500 billion in the exchange loss alone.

The nine major firms' net worth averaged 5.41 per cent of total capital as of March, 1981 — one-third of electric utilities' and steelmakers' ratio of net worth to total capital.

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SCIENCE AND TECHNOLOGY

SIX ALUMINUM SMELTERS TO JOIN MITSUI GROUP PROJECT

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 964, 21 Jul 81 p 6

[Text]

The six major aluminum smelting companies here have decided to join in the joint developmental research on a carbothermical aluminum production method being undertaken by three Mitsui group companies.

The carbothermical aluminum production method, when practicalized, will open the way for Japanese aluminum smelters to strengthen their international competitiveness since it uses much less electricity than the present electrolytic cell process.

The new method uses a blast furnace and coke as a main energy source. A special aluminum-containing clay abundant in Japan, coke and a solvent are fed into the blast furnace to directly extract aluminum.

The present bauxite-based aluminum smelting process requires nearly 15,000 kilowatts/hour of electricity per ton of aluminum ingots produced.

In order to reduce the electricity consumption to around 10,000 kw/h, the Japan Aluminium Federation has been studying an aluminum chloride process but this study has so far been not so successful.

The three Mitsui group companies — Mitsui Alumina Co., Mitsui Mining & Smelting Co. and Mitsui Aluminium Co. —— thus are developing a blast furnace process aluminum production method. They succeeded in extracting relatively high-purity aluminum in an experimental blast furnace last year. They want to continue the research in collaboration with the Government's Agency of Industrial Science & Technology.

The six major aluminum smelters also wish to participate in the research. They are Nippon Light Metal Co., Showa Keikinzoku K.K., Mitsubishi Light Metal Industries Ltd., Sumitomo Aluminium Smelting Co., Mitsui Aluminium Co. and Sumikei Aluminium Industries Ltd.

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SCIENCE AND TECHNOLOGY

MITI HOPES TO FORM GROUP TO PROMOTE URANIUM ENRICHMENT PROJECT

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 964, 21 Jul 81 p 6

[Text]

The Ministry of International Trade & Industry will try to have nine electric utilities and three uranium enrichment equipment makers form a joint committee to help promote an enrichment enterprise with Australia. The Japanese-Australian enrichment venture, as conceived by MITI, combines Japan's technology with the partner country's uranium resources. Most of the enriched uranium will be supplied to the power industry here. The joint venture has been studied by the two Governments since the top-level agreement in November, 1974.

The committee of 12 companies will serve as a core once the joint enrichment venture plan was finalized between Tokyo and Canberra. MITI wants to start feasibility studies with Australia. Their cooperation until now included submitting by Japan of technical information. Encouraged by possibilities of collaboration, the Australian Government instructed a 4 company enrichment group to start detailed feasibility studies.

MITI envisages joint feasibility studies, with the Japanese participants slated to include equipment makers, Mitsubishi Heavy Industries, Ltd., Hitachi Ltd. and Toshiba Corp. The Ministry believed that, although Canberra is interested in feasibility studies with European companies, Japanese will be picked up as partners primarily because of planned supply of enriched uranium to utilities here.

The plant to be sited in Australia will have an initial capacity of 300 tons separative work units a year. One ton SWU is equivalent to consumption of fuel by a 10,000-kilowatt atomic energy plant for one year.

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SCIENCE AND TECHNOLOGY

MITI PLANS TO DEVELOP QUALITY ROBOTS

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[Text]

The Ministry of International Trade & Industry has reportedly started plans to introduce a seven-year ¥30 billion national research and development project, beginning next April 1, to develop "intelligent" robots, including one that assembles a machine, a mechanical "seeing-eye," an earth digger, a nuclear power plant builder, a space factory builder, and an ocean development floating plant builder. A new research and development group to be created by MITI will be responsible for the "nationally important major technology development scheme," sources close to MITI said.

Initial key study themes include development of small, lightweight devices to make the limbs and other active mechanisms of each robot and sensors to make such seeing, hearing, speaking and other sensing systems, as well as control systems and language understandable to humans.

The popularity of industrial robots has been picking up such a momentum in Japan that in fiscal 1980 domestic industrial robot production shot up 85 per cent in value over the year before to total ¥78.4 billion. The annual growth in output is expected to keep rocketing up by an average of at least 50 per cent until 1990 to build Japanese robot production into a ¥1,000 billion industry.

MITI has seen the need for more adaptability of robots and wider application, such as to general office and even household and personal uses. It also sees the need to build robot technology and to pull away from past reliance on imported Western knowledge.

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SCIENCE AND TECHNOLOGY

FUJITSU FANUC TO USE FIBER OPTICS FOR NUMERICAL CONTROL WITH SIEMENS

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[Text]

The world's first attempt to apply modern fiber optics to the production of numerical control systems is being planned by Fujitsu Fanuc Ltd. of Tokyo, it was recently learned. Machine tools can be commanded by flashing light through hair-thin plastic fiber lines.

According to the top-rated Japanese maker of NC systems, it has decided to try the venture on its proposed joint product with Siemens A.G. of West Germany.

The "System X," now being developed at its laboratory under an extensive technological cooperation pact with Siemens, will be an innovational NC system that could be called "a second generation" of such facilities. It will also be useful for controlling all sorts of industrial robots, for which demand is now explosively mounting both in Japan and abroad.

The System X, with a built-in microprocessor of the 16-bit parallel processing type, currently the most advanced, industrially applicable specialized midget computer, will have a high enough capacity to equal that of the minicomputer, the smallest full-fledged computer.

The System X will also be far better in cost-performance than the best conventional NC devices. The magnetic bubble memory "brain" has a huge memorizing capacity.

On top of this, all its instructions to many machine tools under its control, including transmitting commands, receiving information and giving corresponding instructions, with accompanying input and output devices for the human operator, will be done through a fiber optics system.

In the case of telephone communication, a single optical fiber line is capable of transmitting 100,000 circuits of contact, perfectly free from the effects of external electric current or pressures usually jarring the conventional telecommunication wires and cables.

Such fiber lines will be used on the new NC system for the decided benefits of simultaneously sending various information, promising structural miniaturization of the whole NC system, and isolating the system from jarring electrical and other workshop impact.

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SCIENCE AND TECHNOLOGY

STEADY GROWTH IN EXPORTS OF AUTO KITS FOR KD ASSEMBLY REPORTED

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[Text]

Japan's exports of automobile kits for overseas knocked-down production are steadily increasing in contrast with a lull in exports of completed cars.

Statistics show that KD kit exports in the January-May period of this year totaled some 203,100, up 16.4 per cent from the same term of last year.

Honda's exports of KD kits, though small, swelled by 3.3 times over a year earlier. Similarly, exports by Nissan Motor and Mitsubishi Motors increased by 28.9 per cent and 19.7 per cent, respectively.

Exports of KD kits took a conspicuous upturn in March. After dropping by 10.7 per cent in January and rising by 12.6 per cent in February, exports in March climbed by 25.2 per cent, and in April burgeoned by 41.4 per cent.

Behind the gain in KD kit exports is the industrywide efforts to meet the policies of developing countries to promote more nationalization of automobile production.

South Africa and Mexico, major KD kit destinations, place a ban on imports of finished cars as a rule. Also, Taiwan and Australia put domestic production ratio to imported contents at 70 per cent and 85 per cent, respectively.

Exports of KD Kits by Maker

Maker	1978	1979	1980	Jan. May 1981
Nissan Motor Co	148,925	178,726	183,292	87,767
Toyota Motor Co.	70,610	78,510	87,910	36,690
Mitsubishi Motors Corp	41,376	62,250	76,716	32,580
Toyo Kogyo Co.	55,060	65,180	74,120	34,060
Honda Motor Co.	6,100	5,400	7,000	8,560
Fuji Heavy Industries, Ltd.	8,250	13,700	9,500	3,500
Others	—	300	530	—
Total	330,321	404,066	439,068	203,157

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SCIENCE AND TECHNOLOGY

SEMICONDUCTOR COMPANIES EYE GREATLY INCREASING SEA DEMAND

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[Text]

Japanese-Affiliated Semiconductor Plants in Southeast Asia

	Date of establishment	Number of employees
Hitachi Semiconductor (Malaysia) Sdn. Bhd.	Nov., 1972	1,500
Toshiba Electronics Malaysia Sdn. Bhd.	Mar., 1974	1,000
NEC Malaysia Sdn. Bhd	July, 1974	1,200
NEC Singapore Pte. Ltd.	May, 1976	250
Matsushita Denshi (Singapore) Pte. Ltd.	Dec., 1978	300

Major Japanese semiconductor makers are going to step up production of integrated circuits in Southeast Asia to meet rising demand in local market.

Southeast Asia is emerging as a promising semiconductor market as many Japanese, American and European firms locate their plants there to assemble a variety of consumer electronics.

Greater semiconductor production by Japanese-affiliated companies is expected to stimulate "forerunners" mostly affiliated with American interests. This indicates possibility of the so-called Japan-U.S. semiconductor "war" spreading to the Southeast Asian market.

Hitachi, Ltd., Toshiba Corp. and Nippon Electric Co. (NEC) have a plant in Malaysia, and NEC and Matsushita Electronics Corp. operates one in Singapore.

Hitachi Semiconductor (Malaysia) Sdn. Bhd. has started manufacturing 16-kilobit random access memory (RAM) chips to replace a part of their production in Japan. As it also produces silicon transistors and bipolar ICs, the production value of the Malaysian plant will reach ¥7-8 billion this year, compared to ¥6 billion last year.

Matsushita Electronics plans to have its Singapore subsidiary double monthly output of bipolar linear ICs and small-signal transistors to 5 million and 30 million units, respectively. Most of the products will be supplied to Matsushita-affiliated plants in Southeast Asia which produce color TV sets, radios, tape recorders and stereo sets.

In contrast, NEC has been marketing semiconductors produced in Southeast Asia to local consumer electronics makers affiliated with American and European capital, including N.V. Philips. NEC Malaysia Sdn. Bhd. will boost output of transistors to 50 million units monthly from 36 million units and that of household linear ICs to 13 million units from 10 million units. The Malaysian subsidiary will newly take up production of industrial linear ICs — several million units monthly.

NEC Singapore Pte. Ltd. will build a transistor manufacturing plant with a floor space of 6,600 square meters in order to further increase production.

Toshiba plans to invest ¥700 million in its Malaysian subsidiary to boost output of small-signal transistors to 40 million units monthly from the present 30 million units and linear ICs to 3.5 million units from 2 million units. The increased output at Toshiba Electronics Malaysia Sdn. Bhd. will be shipped to Japan to meet rising demand mainly from video tape recorder makers.

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SCIENCE AND TECHNOLOGY

NEW WAY FOUND TO SEVER SUPER THICK STEEL PLATINGS UNDER WATER

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[Text]

A new way to cut underwater very-thick steel platings covered with stainless steel, believed to be effective for both marine engineering jobs and for dismantling radioactive steel structures of nuclear power plants, has been developed by the Government's Industrial Research Institute, Shikoku, of the Agency of Industrial Science and Technology, it was recently learned.

According to the institute at Takamatsu, a regional research arm of the agency belonging to the Ministry of International Trade and Industry, its new achievement follows earlier development of a similar underwater cutting method for exceptionally thick stainless steel plating, such as is used for fast-breeder reactor pressure vessels. The new method consists of two stages, first cutting a groove through the stainless steel coating of very thick steel plating, and then oxidizing the gas cutting of the parent steel plating.

Apart from marine engineering, such underwater dismantling of unused N-power plant structures has become necessary in Japan, as in all other nuclear power developing countries, because underwater cutting is the only safe way to separate such bulky structures for ultimate dumping. In building a new N-power station by pulling down a disused one, simple wrecking in the atmosphere poses the danger of spreading radioactivity.

Various ways of cutting used N-power plant steel plating have been developed in the U.S. and in Japan, including a water-jet method, an arc saw method, and a plasma-cutting method. An American-developed plasma-cutting method applied to a research nuclear reactor has reportedly worked in cutting underwater a 76-mm-thick piece of stainless steel-clad steel plate.

Japan's Ishikawajima-Harima Heavy Industries Co (IHI) has developed its own underwater plasma-cutting method to sever 2 mm-thick steel plating at a speed of 2 meters a minute. The company plans to improve its method and apply it to dismantling an unused N-power plant material testing reactor of the governmental Power Reactor & Nuclear Fuel Development Corp. But the plasma-cutting method is said to have become deadlocked in the U.S. because it cannot cut through steel plating of 130 mm or thicker. Research reactor plating is usually thinner and easier to cut, but commercial reactor types reach anywhere between 150 and 300 mm in thickness.

According to the government institute, it developed its own method after studying the plasma-cutting method and another promising way known as the powder method. The latter is to mix powdered iron in an oxygen gas used for cutting and do the severing job by the heat of chemical reactions occurring between oxygen and dust iron and also collision of the dust iron with the surface of the steel plating. The plasma method is to generate an electric discharge arc between a tungsten electrode and the steel plating and cut by strongly concentrating the arc. But the powder method has been found to have a frequent trouble of the heat-producing point becoming wet and inhibiting the dust iron flow. The plasma method has been found to pose the danger of electric shock when the arc voltage has to be sharply raised for thicker plating. Besides, a shielding gas of argonne or helium needed has been found to be hard to reclaim because it catches much radioactivity.

The institute's oxygen gas cutting method essentially utilizes the heat of oxidizing reactions between oxygen and softer steel making up the parent material of stainless-clad steel plating. But the stainless steel covering obstructs cutting because its chromium content reacts with oxygen to produce chromium oxide, a substance with a high melting point.

The institute thus has devised the two-stage method to lay either a rod of carbon or a piece of soft steel wiring on the stainless steel, and create an electric charge arc in between. All resulting molten metal is swept away by jets of water. A groove is thus dug through the stainless covering. Then the parent steel plating, after being pre-heated with a mixture of oxygen and hydrogen (or acethylene) gases, is cut off by the oxygen-soft steel chemical reaction heat.

To keep water from the pre-heating and cutting section, a strong circular curtain of water jets is spewed through a ring of nozzles. Inside that ring, there is a pre-heating gas nozzle and a cutting gas nozzle. The whole extraordinary underwater "torch" is made easy to ignite by creating sparks of a high-frequency electric current between an electrode tip and the torch tip.

The new method has so far proved so effective as to cleanly cut off 150 to 250 mm (15 to 20 cm) thick stainless-clad steel plating. If enlarged, the torch could cut through even 300 mm thick ones.

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SCIENCE AND TECHNOLOGY

NIPPON KOGAKU DEVELOPS UNIQUE INDICATOR FILM

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[Text]

A thin chemical compound type of electronic illumination filming that has prospects of becoming a new indicator material by offering clear visibility in all directions has been developed by Nippon Kogaku K.K.

The Nikon camera and optical instrument maker said the new filming formed of some chemical compounds, containing nickel and tungsten, was developed on the basis of an idea of Prof. Yoichi Murayama of Toyo University, as the company's technology development service for the semigovernmental Research Development Corporation of Japan.

The company said it had been well known that such chemical compound filming coming in a transparent condition, when charged with electricity, such as 1 to 2 volts, emits a very strong blue-colored light, but if not electrified, it remains quite transparent. Thus, utilization of such filming for cameras, microscopes, watches, electronic calculators and many other indicator-requiring products had been envisioned, but it had been technologically difficult to produce such filming of just a few microns in thickness and a transparent electrode.

The company solved the problems by developing its own "Ion Plating Process" to produce such compounds of high precision by heating up materials with a high frequency electric coil as well as its own new method of making a transparent electrode.

The resultant product proved to be incomparably stronger in color shade than the liquid crystal display devices, in addition to its visibility from anywhere.

Its luminescence comes from two layers sandwiching an insulation layer, with the lower layer made of nickel hydroxide to light up by an oxidizing reaction and the upper layer tungsten oxide by a reducing reaction. But the new product still leaves one technical problem to be solved — 10 to 100 times as much time as the liquid crystal to react to electric charging.

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SCIENCE AND TECHNOLOGY

LASER BEAM BOMBARDMENT USED FOR FILMING WORK ON SEMICONDUCTORS

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[Text]

A simple, fast, and sure method of forming oxidized filming on the surface of semiconductor substrates by means of laser beam bombardments has been developed by a technical college research team.

According to the team, led by Prof. Tetsuro Nakamura, of Toyohashi University of Technology of Toyohashi City, demand for gallium-arsenic (GaAs) semiconductors has been growing, such as for use in very high-speed computer electronic elements, laser semiconductors, and light-emitting diodes (LEDs).

But it had so far been technologically difficult to form a uniform quality type of the oxidation filming on the surface of the GaAs semiconductor because of its two chemical composition, it says.

To deal with this, two methods, heat oxidation and plasma oxidation, had so far been used. But it had still been difficult to obtain really, reliable semiconductors of the type.

The new method, though still at the laboratory stage, promises high applicability as a very simple, swift, and unfailing method.

A number of such semiconductor substrates are placed in a box. After a vacuum is formed, the box is filled with oxygen gas to anywhere between one and five atmospheres in pressure. All that remains to be done is to flash a laser beam a few times upon the substrates through the box's glass window.

A pulse type of laser device flashing its beams like a camera strobo illuminator is used. Each flash lasts only 13 nanoseconds. The electric power output needed is only one joule.

Adjusting the degree of bombardment so that the light energy density per square centimeter of the substrate surface attains about 1.5 joules, the team has applied six rounds of such beaming to find a 0.2 micron-thick good quality kind of oxidized filming formed on the substrate surface. Localized oxidation has been also possible, and the need for preheating the substrate at the risk of quality changes as seen in conventional methods has been eliminated.

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SCIENCE AND TECHNOLOGY

RED LIGHT DIODE HAVING BRILLIANCE OF FIVE TIMES DEVISED

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[Text]

A red light-emitting diode about five times as brilliant as conventional ones has been developed by Stanley Electric Co. of Tokyo.

According to the company, such semiconductors giving off bright light when electrically charged have already been commercially produced in various colors including infra-red, red, orange, green and blue. They have been widely used in electronic indicating devices or, in combination with photoresistors, as photo-couplers between two electric or electronic devices. But their general lack of brilliance and low efficiency in large-scale communication, signalling and other purposes, has been a technological bottleneck to wider marketing.

Stanley Electric was the first in Japan to break the bottle-neck by its development, some time ago, of its own red light emitting diode made of a compound of three elements, gallium, aluminum and arsenic. It generated 200 milli-candela at 1.7 volts and 20-milli-amperes. The conventional gallium-phosphorous or gallium-arsenic-phosphorous equivalents are still so low in brilliance as to have attained only 100 milli-cd or even less under the same electric charging conditions.

This time, the company has come up with a far more brilliant version. The brightness is 5 to 10 times higher than its own last outstanding product.

In converting electricity to light, the new product has attained about 4 per cent efficiency, compared with only 1.6 of its predecessor.

The company has attributed its new achievement to a special "temperature difference (utilizing) multi-layer continuous liquid phase build-up" process developed by Prof. Junichi Nishizawa of Tohoku University. The secret of the process lies in producing semi-conductor chemical compounds free from defects. The company envisions wide application of its new LED, through some reduction in its still high cost and price, to short-distance fiber optics communication lines, traffic signals, large flicker warning lights and light-controlled electronic elements.

LED and related equipment now account for nearly 10 per cent of the company's annual sales.

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END