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10 September 1981

Japan Report

(FOUO 54/81)

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JAPAN REPORT

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CONTENTS

Briefs

ECONOMIC

GROWTH IN POSTAL SAVINGS PORTRAYED IN GRAPHIC FORM

Tokyo NIHON KOGYO SHIMBUN in Japanese 21-24, 28 30 Apr, 1, 7, 8 May 81

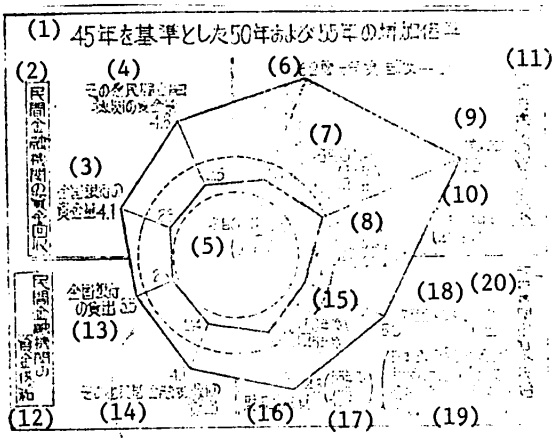
[21 Apr 81 p 3]

[Text] 1. Expansion of Government Financing and Postal Savings

The battle between private financial institutions and the Ministry of Posts and Telecommunications over postal savings continues to escalate. The private sector claims that unlimited expansion of postal savings will wreck the national economy and must be stopped. The government replies that postal savings is actually on the side of the people. It is necessary to wait for the deliberations of the Postal Savings Discussion Group to settle the matter. However, Figure 1 shows the status of postal savings and its influence on private financial institution based on data of the Local Banks' Association of Japan.

Figure 1 shows the change in the relative weight of government financing in the national economy. In the 10-year period beginning in 1970, the volume of funds and of loans in all Japanese banks has grown by 4.1 and 3.5 times respectively. The growth of government financial institutions has been much greater. The expansion of postal savings has been especially dramatic: 8.2 times, double the growth of banks. This rapid growth of postal savings has created the basic problem. The private banks have been losing their funds to postal savings, which they criticize severely as "a model of government oppression of the private sector."

Figure 1.



Key:
1. Rate of growth for 1975 and 1980 Taking 1970 as the Standard
2. Funds collected by private financial institutions
3. Fund volume of all Japanese banks
4. Fund volume of other private financial institutions
5. Nominal GNP (1975/1970)
6. Postal life insurance and pension funds
7. Nominal GNP (1980/1970)
8. (1975 end of Sep/1970 end of Sep)
9. Postal savings
10. (1980 end of Sep/1970 end of Sep)

[Key continued on following page]

[Key for figure 1 on previous page]

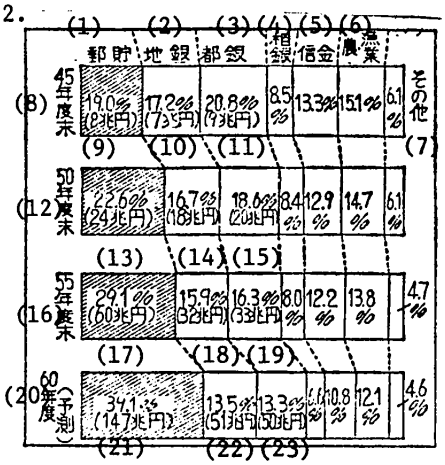
11. Funds collected by government institutions
12. Fund supply of private financial institutions
13. Loans from all Japanese banks
14. Loans from other private financial institutions
15. (1975/1970)
16. Government investment and loan program
17. (1980/1970)
18. Loans from government financial institutions
19. (data taken from the Bank of Japan's "Monthly Report on Economic Statistics" and the Ministry of Finance's "Monthly Statistical Report on Government Financing")
20. Fund supply of government institutions

[22 Apr 81 p 3]

[Text] 2. Share of Personal Savings Held by Different Types of Financial Institutions

Figure 2 shows how much of personal savings goes into which financial institutions. At the end of 1970, there was 8 trillion yen, or 19 percent of the total, in postal savings. After that it grew rapidly until at the end of December 1980, there was 60 trillion yen, or 29.1 percent. In 1985, it is expected to reach 147 trillion yen, or 39.1 percent. During this period, the share of both city and regional banks has continued to fall. In December 1980, the total for banks was 65 trillion yen, or 32.2 percent, just slightly over postal savings. This lead seems certain to be reversed in 1 or 2 years. The banks have a strong sense of danger. (data from the Local Banks' Association of Japan)

Figure 2.



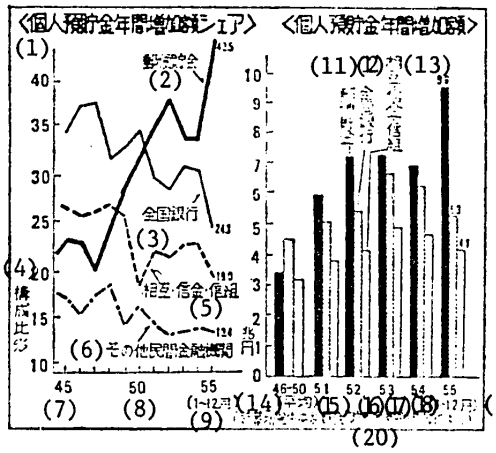
1. Postal saving
2. Regional banks
3. City banks
4. Mutual savings and loan banks
5. Credit association
6. Agriculture and fishery cooperatives
7. Miscellaneous
8. end of 1970
9. 8 trillion yen
10. 7 trillion yen
11. 9 trillion yen
12. end of 1975
13. 24 trillion yen
14. 18 trillion yen
15. 20 trillion yen
16. end of 1980
17. 60 trillion yen
18. 32 trillion yen
19. 33 trillion yen
20. 1985 (estimate)
21. 147 trillion yen
22. 51 trillion yen
23. 50 trillion yen

[23 Apr 81 p 3]

[Text] 3. Share and Amount of Increase of Postal Savings

In Figure 3, the line graph on the left shows the changes in percentage of increase in personal savings accounted for by postal savings. The bar graph on the right shows the actual amount of annual increase in savings. Postal savings captured the top share of annual increase in 1975 and continued to rise rapidly, while the share of private financial institutions declined. In 1980, it took a decisive lead at 43.5 percent. In the actual amount of increase as well, it has held the lead since 1976. In 1980 it raced ahead to 9.6 trillion yen, 4.3 trillion yen ahead of all banks. The post office claims that this is due to widespread recognition among the people of the role played by postal savings and its active service to savers. However, it remains a fact that the plan for introduction of the green card system has caused a shift of large amounts of money to postal savings. At any rate, it must be said that this sudden capture of almost half of total savings is abnormal. (Data from the Local Banks' Association of Japan)

Figure 3.



1. Share of Annual Increase in Individual Savings Accounts
2. Postal savings
3. All banks
4. Percent of total
5. Mutual savings and loan banks, credit associations, credit unions
6. Other private financial institutions
7. 1970
8. 1975
9. 1980 (January-December)
10. Amount of annual increase in personal savings accounts
11. Postal savings
12. All banks
13. Mutual savings and loan banks, credit associations, credit unions
14. 1971 to 1975 (average)
15. 1976
16. 1977
17. 1978
18. 1979
19. 1980 (January-December)
20. (According to "Savings Statistics for Reference" issued by the Central Committee for Savings Increase)

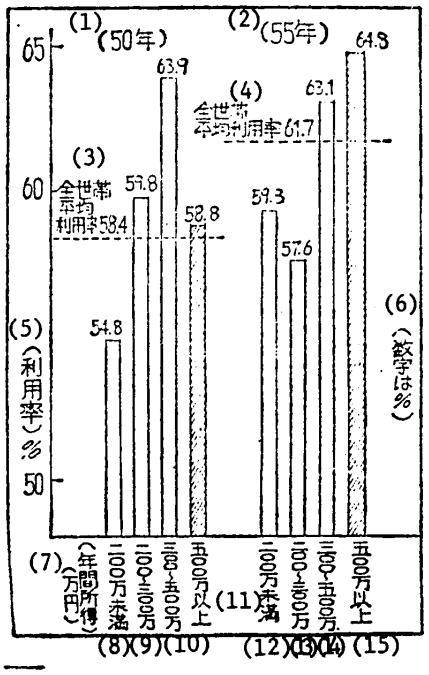
[24 Apr 81 p 3]

[Text] 4. Frequency of Use According to Income

Figure 4 examines the people using postal savings in terms of annual income. Comparing 1975 and 1980, we find that the use of postal savings by the income group below 2 million yen increased from 54.8 percent to 59.3 percent, an increase of 4.5 percent. In the group between 2 million yen and 3 million yen and the group between 3 million yen and 5 million yen, there was a slight decrease in use. However, in the group above 5 million yen, the use of postal savings during this 5-year period rose from 58.8 percent to 64.8 percent, an increase of 6 percent, making it the highest group in frequency of use--more than 3 percent above the average rate of

use of all income groups together. Private financial institutions see this situation as proof that the rich are more likely to use postal savings. They protest fiercely: "The claim of the postal service that postal savings is a friend of the people is a lie. People with higher incomes are making money from postal savings." (data from the Local Banks' Association of Japan)

Figure 4.



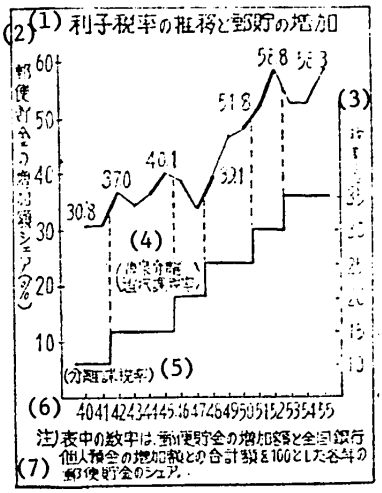
1. 1975
2. 1980
3. Averate rate of use of all households
4. Average rate of use of all households
5. Rate of use
6. Figures given are in percent
7. Annual income (units of 10,000 yen)
8. Below 2 million
9. 2 million to 3 million
10. 3 million to 5 million
11. over 5 million
12. below 2 million
13. 2 million to 3 million
14. 3 million to 5 million
15. over 5 million

[28 Apr 81 p 3]

[Text] 5. Difference in Taxation

Figure 5 shows the shift in the tax rate on interest and the corresponding growth of postal savings. Private financial institutions say that the reason for this growth in postal savings is that interest on savings in private institutions is subject to tax in principle, and postal savings is not. Another important factor is that the post office is lax in confirming the identity of savings account holders and controlling the established limits. It is true that in the past whenever the tax rate for separate taxation at source on interest in private savings institutions was raised, there was a dramatic increase in postal savings that year over the previous year, as indicated by the heavy line on the graph. The private financial institutions angrily claim that this unfairness in the tax system and laxity in operation is the "underlying strength" supporting postal savings. (data from the Local Banks' Association of Japan)

Figure 5.



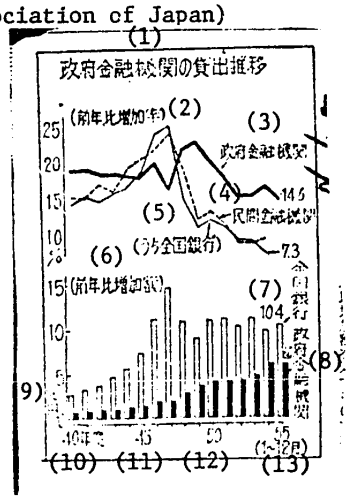
1. Shift in interest rates and growth of postal savings
2. Increase in share of savings held by post office (%)
3. Tax rate
4. (Optional tax rate for separate taxation at source)
5. Separate tax rate
6. 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980.
7. Note: The figures given in the graph are the annual percentage of total increase in savings accounted for by postal savings. This is based on the total increase in postal savings and personal savings in all Japanese banks taken as 100.

[30 Apr 81 p 3]

[Text] 6. Expansion of Government-Related Financial Institutions

There has been a tremendous expansion in the Trust Fund Bureau funds, the main source of which is postal savings. Corresponding to this, there has been an expansion of the government loan and investment program. In Figure 6, the line graph shows the annual rate of growth over the previous year in loans from government-related financial institutions. The bar graph shows the same annual rate of growth. We can see that the rate of growth itself began to decline from the latter half of 1965, but that the gap between the public and private institutions has widened (the Norin Chukin Bank, the agricultural and fishery cooperatives, and life and accident insurance companies are included in private financial institutions). This great expansion of government-related financial institutions results in a penegration into areas in which the money supply should be regulated by private market mechanisms. The private financial institutions emphasize that "oppression of private industry and many disadvantages to the national economy are occurring." (data from the Local Banks' Association of Japan)

Figure 6.



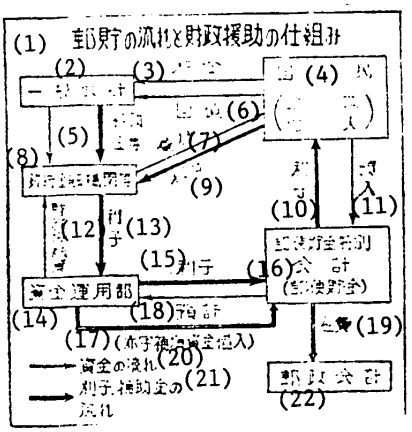
1. Change in volume of loans made by government-related financial institutions
2. Rate of growth over previous year
3. Government financial institutions
4. Private financial institutions
5. Banks alone
6. Rate of increase over previous year
7. All banks
8. Government-related financial institutions
9. trillion yen
10. 1965
11. 1970
12. 1975
13. 1980 (January-December)

[1 May 81 p 3]

[Text] 7. Postal Savings and The People's Tax Burden

The funds collected through postal savings are used by government institutions at low interest as part of the government loan and investment program. These institution are also assisted in the form of expenditures and loans from general accounts. Private financial institutions hold that the high interest from postal savings is covered by the people's tax money. They point out that in 1980 this tax burden reached 1 trillion yen, or one-third of the interest paid on postal savings. Figure 7 shows the composition of the flow of postal savings and government financial assistance. As postal savings expands within this system, the tax burden on the people also expands. Private financial institutions claim: "There is a basic problem in the structure of the system. The content of the postal savings special account and the cost of the entire mechanism for using the postal savings funds should be made public and an explanation should be provided in response to the doubts held by the people." (data from the Local Banks' Association of Japan)

Figure 7.



1. Postal savings flow in relation to system for government financial assistance
2. General accounts
3. Taxes
4. People (industry, individual)
5. Subsidies, etc
6. National bonds
7. Loans
8. Government financial institutions, etc.
9. Interest
10. Interest
11. Savings deposits
12. Government loans and investment
13. Interest
14. Trust Fund Bureau
15. Interest
16. Post Savings Special Account (postal savings)
17. (funds borrowed to compensate for debts)
18. Deposit
19. Operating expenses
20. Flow of funds
21. Flow of interest and subsidies
22. Ministry of Posts and Telecommunications Account

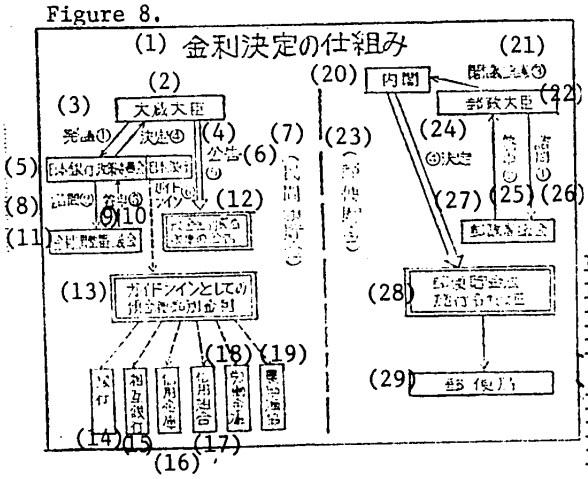
[7 May 81 p 3]

[Text] 8. Dual System for Determining Interest

Flexible changes in overall interest on savings are necessary to make interest policy effective. As shown in Figure 8, interest is determined separately for private savings and postal savings. The private sector points out that this dual system has the disadvantage of slowing the timing of interest changes and reducing the scale of interest reductions. "The dual system for determining interest is a prime obstacle to mobility and flexibility in interest policy." Of course, with the tremendous

expansion of postal savings, it is impossible to think about interest on savings without considering interest on postal savings. The large shift of savings to postal savings has oppressed the operation of private financial institutions. They desperately want an early unification of the system for determining interest. (data from the Local Banks' Association of Japan)

Figure 8.



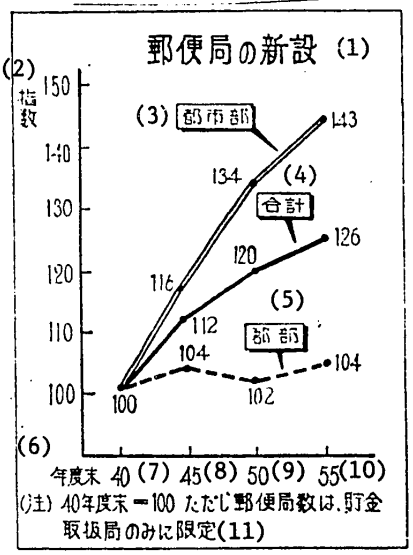
1. System for Determining Interest
2. Minister of Finance
3. Proposal
4. Decision
5. Bank of Japan Policy Board/Bank of Japan
6. Promulgation
7. Private savings accounts
8. Questioning
9. Report
10. Guidelines
11. Interest Regulation Council
12. Announcement of maximum
13. Guidelines on interest according to type of deposit
14. Banks
15. Mutual savings and loan banks
16. Credit associations
17. Credit unions
18. Labor union funds
19. Agriculture and fishery cooperatives
20. cabinet
21. cabinet proposal
22. Minister of Posts and Telecommunications
23. Postal savings
24. Decision
25. Report
26. Questioning
27. Postal Ministry Council
28. Revision of Enforcement Order for the Postal Savings Act
29. Post offices

[8 May 81 p 3]

[Text] 9. Postal Savings Offices

Figure 9 shows the expansion of urban and rural offices handling postal savings. As of March 1965, there were 9,087 in cities. By March of 1980, this number had grown by 43.2 percent, to 13,012 offices. The number of rural offices increased by only 3.8 percent, from 8,789 to 9,919 offices. Private financial institutions criticize this concentration of new post offices in the cities as follows. "A government enterprise should concentrate on rural areas where it is difficult for private enterprise to establish offices. In spite of this, postal savings has concentrated totally in cities in order to expand savings deposits without regard even for appearances." Regardless of whether the private institutions are totally correct in their assertion, the tremendous discrepancy between 43.2 percent and 3.8 percent deserves notice. (data from the Local Banks' Association of Japan)

Figure 9.



1. Establishment of New Post Offices
2. Index
3. Urban
4. Total
5. Rural
6. end of fiscal year
7. 1965
8. 1970
9. 1975
10. 1980
11. Number at end of FY65 taken as 100; number of post offices limited to those with a postal savings department

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SCIENCE AND TECHNOLOGY

MECHANICAL SEQUENCERS DESCRIBED

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 pp 11-17

/Article by Motoji Watanabe, Rinei Seiki Co., Ltd.: "Mechanical Sequencers"/

/Text/

Sequencers have been rapidly and extensively popularized as an effective means of labor saving and automating production equipment while also increasing flexibility and reliability. In addition, they have been becoming increasingly diversified and large-scaled. In order to carry out control for automation, sequencers must be used while selectively making use of features from various models ranging from simple relay sequencers to mini-computers. In other words, it is usual to perform simple sequential control with sequencers of such types as relays, drums and pinboards, while using microcomputers for general-purpose machines, inspection and test systems, and multi-line small-lot assemblers, and leaving control of equipment, including production control, to mini-type and large-capacity computers.

This article deals with typical rotary-cam sequencers in accordance with the theme of mechanical sequencers. In practice, we can find around us a variety of sequencers in use which have constant-speed cams (drums) for sequential operations. Devices frequently seen in daily life include sound generators, such as automatic organs designed to produce sound upon manual revolution of handles, and which can be found in Western dramas, music boxes, Edison's phonographs and records, and timer-operated devices such neon signs, traffic signals, and autoamtic washers and cleaners. Production machines we deal with here include a variety of automations which use actuator operations, such as pneumatic pressure, that permit operational processes to be dissolved. In addition, for automatons composed of cylinders, solenoids, etc., cam sequencers, as shown in Photo 1, are often used.

1. Rotary Cam Sequencers

Rotary cam sequencers pick up signals by rotating a cam shaft fitted with a number of cams or drums to operate switches at their locations. Because they are inexpensive and easy to use and understand, they are in wide use for simple automation. In particular, when machine designers completely design automa-

tons (including everything up to control) they readily use cam sequencers, which are sensitively very clear and do not involve the problem of strict requirements for temperature and electrical noise.

There are numerous applications of cam sequencers. Here, because of limited space, only a few applications are described. Photo 2 shows an automatic characteristic-value sorter for trimmer resistance elements and represents an application of a sequencer for controlling the operation of a measuirng probe, the timing of measurement, the operation of a work shutter, and resetting. Photo 3 shows a control box for an automatic high-viscosity paste multi-nozzle dispenser. This machine is injection-variable. Given necessary specified dispensing points, it operates automatically in accordance with the sequence. Sequence speed is also variable.

Photo 4 shows an application in the sequence of a work chuck and the vertical and swiveling operation of a pneumatic autoloader.

2. Types and Features of Cam Sequencers

Control methods of automatic operation include sequential movement as with a timer, and "end point type" sequential movement.

2-1. Timer Guided Movement

This is the method of moving the object under control in sequence by continuously rotating the cam shaft at a constant speed. Control is that of time and consists of sequential outputting by repeating a cycle of sequence, without the necessity of feedback from the object being controlled. Thus, it permits the simplest and cheapest application in automation if done appropriately. Naturally, with objects with a specific operational speed such as actuators, it is necessary to complete specified operations within the time assigned for individual steps (see Fig.1). The cycle time of the machine corresponds to one revolution of the cam shaft.

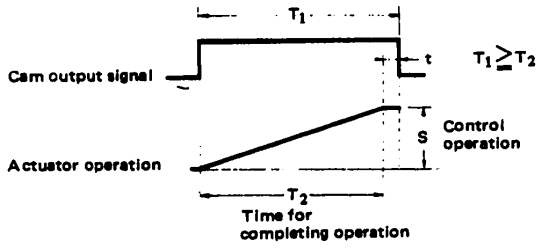

Fig. 1. Assigning of Cam Timer Operation Time

2-2. End Point Shifting

This type proceeds to the subsequent step in accordance with operation acknowledgement signals (completion signals) from the controlled object, and allows the controlled object in the subsequent process to operate. It enables control operation to be performed properly. However, it is somewhat complicated as it requires detectors for completion of operations (including amplifiers and output relays) and their interfaces.

3. Driving of Cam Sequencers

The speed of sequence steps depends on the revolutional speed of the cam shaft and on the profile of the cam.

3-1. Revolutional Speed of Cam Shaft

The revolutional speed of the cam shaft is set by a combination of the output speed of drives such as motors and speed change gears.

3-1-1. Driving Motor

The method of rotating the cam shaft is either revolution, using a motor, or ratchet transfer, using an air cylinder. For driving motors, synchronous motors (used in synchronization) with the frequency of commercial AC power supplied, are most suitable. Alternatively, pulse motors and DC motors can be used. Synchronous motors can run at a constant speed and can stop instantly. DC motors may require an instantaneous stop circuit (see Fig.2) and a stabilizing power supply, and require consideration of the life of wire brushes.

3-1-2. Variation of Sequential Speed

The revolutional speed of the cam shaft can be varied by changing the combination of speed change gears. The period of one revolution can be varied in the range from two sec. to 36 hours with a 50Hz power supply, and in the range from 1.67 sec. to 30 hours with a 60Hz power supply. Furthermore, a reduction ratio of 1 to 36, at maximum, is possible by using a double cam shaft and intermediate gears (see Photo 5 and 6).

Speed controllers (inverters) have been specially designed for synchronous motors, and can be used to make the speed of motors variable (see Fig.3). With a DC motor, speed can be varied by means of a transistor circuit (see Fig.2).

There is also a type which has a pair of motors and a pair of speed change gears, as shown in Photo 8, to provide selectable independent revolutional speeds. This is convenient in making a high-speed return to the sequence zero point, conducting low-speed tests for mechanical adjustment, and making temporal rapid stepping. One application of this type involves using one motor and a speed changing gear for the required sequence, and providing the other with an inverter-type speed control to obtain any speed as required.

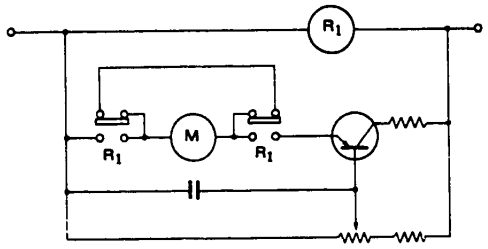

Fig. 2. Control Circuit of DC Motor

3-2. External Driving

This is a type which applies driving externally instead of directly using motors. Because it can be made synchronous with the machine, this type cam be used as a cam for sequence signals at the machine.

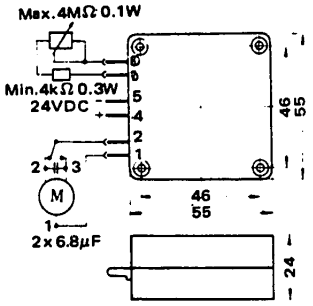

Fig. 3. Motor Speed Controller (24V DC)

4. Sequence Cams

Sequence step speed depends on the profile of the cam. The profile is determined by the locations and the lengths of the crest and vale of the cam.

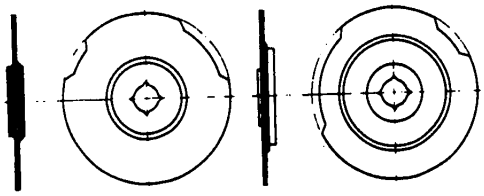

Fig. 4. Simple Plate Cam

4-1. Types of Cams

The types of cams used in sequencers include the following:
(1) Fixed disk cam – made by fitting a disk, with vale portions removed, on a cam shaft (see Fig.4).

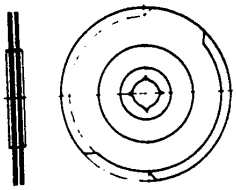

Fig. 5. Double Plate Cam

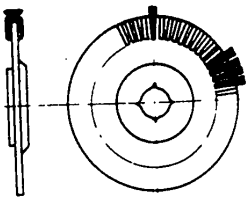

Fig. 6. Clip Cam

(2) Variable disk cam – composed of 2 disks which are movable to make crests and vales variable (see Fig.5).

(3) Pin planted cam – provided with detachable pins (see Fig.6).

Each type has its own features and applications. The fixed disk cam is effective where a first automation is completed, enabling the subsequent units to be standardized, or where more than one vale is needed on a cam or pulse output is required. While the profile of the cam is fixed, there are types which have variable fittings on the cam shaft.

The variable disk cam consists of two cams with a 180° crest and 180° vale joined together with a friction coupling, enabling their relative positions to be variable in the range from 4° to 356°. This type is effective for trial units and applications which involve later alternations, and thus is in widest use.

The pin planted cam has clip pins. This is effective in test units and of course can be used in production machines. It has features of both fixed disk cams and variable disk cams. In particular, it has the merit of being variable as a stepping cam. A minimum of 10° is available when a pin is used for pulsing,and a minimum of 5° when a dual pin vale is used for pulsing.

4-2. Materials of Cams

Contact microswitches should optimally be made of dry-lubricated plastic (polyamide plus molybdenum), because they involve friction with action levers. For proximity switches, though contactless, iron-based materials are used because of their sensitivity characteristics .

5. Switches

The timing of cams can generally be determined by adjusting their positions as mentioned above, except that the problem of minute dislocation may be involved owing to slight errors due to differing clearances at various locations. Also in some cases, operation may reveal that design values should be slightly changed. For this delicate adjustment of timing cams are not helpful. Thus, special types of microswitches having a micro-adjusting structure should be used . These micro-switches are capable of micro-adjusting the switching points precisely enough to increase the accuracy of sequence.

Photo 12 shows a roll-action type microswitch which can be easily attached and detached. In addition, proximity switches, photoelectric switches and air switches are also used. When these are used, emphasis is laid on the life of contacts, noise control and preventing explosion, rather than on the accuracy of sequence.

6. How to Determine Cam Sequencers Stepping

6-1. Wiring and Operation

Fig.7 shows a type of wiring for pacing in accordance with the length of the impulse. When X is given an impulse the motor starts packing. If the length of the impulse is less than 30–75% of the time for one step, the motor stops after one step With longer impulses, the motor continues stepping without stopping. In addition, switch Y is for returning to zero. Keeping switch Y depressed in the course of sequence causes the machine to return to zero and to stop there.

Fig.8 shows another type of wiring, in which giving a short impulse to X causes the motor to perform one step in accordance with the vale of cam A, and a long impulse also causes the motor to stop after one step. Here, if X is kept depressed, contacts 1 and 2 of cam A remain "off" and when the vale of cam B comes around, contacts 3 and 1 of switch B are turned "off" to stop the sequence motor. When X is released, contacts 3 and 1 of cam A are turned "on" to finish stepping. A new step toward the subsequent processes can be made by giving a new impulse to X. In this example, in addition, revolutional direction of the cam shaft, or the progress of sequence, is only in one direction. Up to 16 steps are available.

In Fig.9, one step of cam A is performed when an impulse is given to X. Here, even if the impulse is too long, progress does not overrun to the subsequent step. In other words, this wiring assures one step with one impulse. In the Figure, v is interlocked with a dual contact electromagnetic relay. This stepping is possible in either direction, forward or reverse. In the example shown in the figure, revolution is decreased by using an intermediate gear on the cam shaft. In other

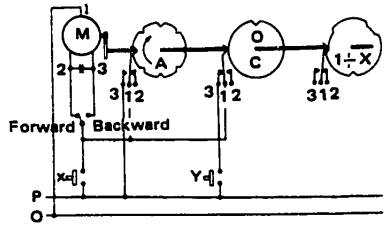

Fig. 7. Connections for Steps and Return to Zero by Impulse

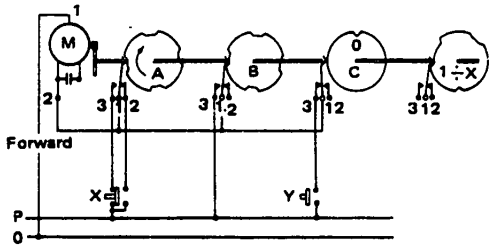

Fig. 8. Connections for One-Step Pacing Even with Long Impulse

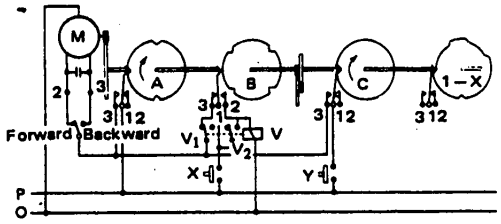

Fig. 9. Connections for One-Step Pacing and Multiple Step, Forward and Backward

words, several revolutions of the cam shaft for stepping A and B make one revolution of the cam shaft of zero point cam C and sequence cam. Switch Y permits single cycle stopping and returning to the zero point. In this example up to 40 steps are available

7. Conbination with Potentiometer

Photo 13 shows a combination of a potentiometer and a cam sequencer. Because the output cam is linked with the potentiometer by means of gear, the current locations of the cam shaft and output can be determined by measured resistance. The cam shaft is driven by the motor in the operational range of the potentiometer: 0 to 270°. In order to prevent overrun, cams A and B are used to establish upper and lower limits (see Fig.10). Giving a signal to cam switch A causes the potentiometer to move toward MAX, and giving a signal to cam switch B causes it to move toward MIN. In application, it is most suited for the control of speeds and temperature, including control involving feedback from purifiers and chemical plants.

8. Making Sequencers Compact

The sequencers described here are very compact and control boxes which incorporate them are also likely to be made compact. Furthermore, with one to four sets of cam switches a sequencer can be made simple.

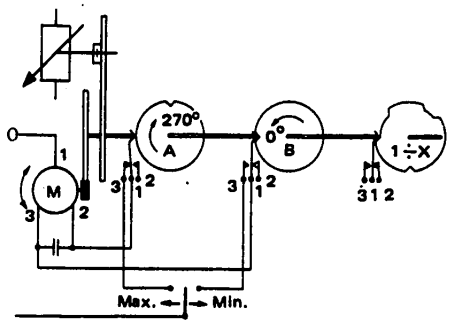

Fig. 10. Connections for Electric Potentiometer

9. Other Cam Sequencers

Other types of cam sequencers include:

(1) a type consisting of end-point cam steppers and electronic timers

(2) a timer-type sequencer, with a very small (25–30mm) cam diameter.

(3) an all-pneumatic cam sequencer.

(4) a type with fluted cams which are to be notched in accordance with the specific program.

10. Sequencers for Pneumatic Loaders

Full-pneumatic sequencers do not use electric power (see Photo 15), and are very compact and simple. Required operational control can be made directly by connecting vertical and swiveling loader chucks to respective nipples, and sensors to connectors. They require no motors, solenoid valves, sensors, amplifiers, etc. They are made up of simple parts, as shown in Photo 16, and can easily be disassembled and assembled by anyone. Their operations step along end points. A typical loader is shown in Photo 17 and steps along vertical, swiveling and vacuum chucks (step numbers: (1)–(2)–(3)–(4)–(5)–(6)–(7)–(8)–(11)).

Sensors are provided at 6 locations: the upper limits, the work suction lower limit, the work feed lower limit, the clockwise swiveling stopper, the counter clockwise swiveling stopper, and the work suction, which will be provided with operation acknowledgement signals.

The cylindrical portions of sequencer cams are fluted so that air channels are sequentially connected or disconnected in accordance with the steps. A developed view of a fluted cam is shown in Fig.12. Fig.13 shows a diagram of a loader operation and Fig.14 illustrates principles of sequencer operation. Compressed air is taken in at P_1 and after throttling, is supplied to (A) and (B) of the sequencer at high pressure P_2 (2–3kg/cm^2). In the step in which the loader moves upward, (C) of the loader is reached by the fluted cam of the sequencer and P_2 air is supplied to cylinder S_1, causing the loader to ascend. When the loader reaches the upper stopper, movement stops. The air taken in from (A) is depressurized to p after it passes the throttle and is then supplied to loader sensor (D) and stepping cylinder (E). While sensor (D) is open, low pressure p

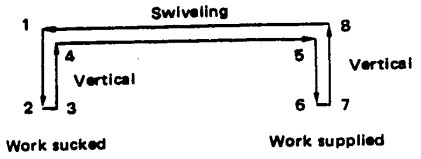

Fig. 11. Loader Operation

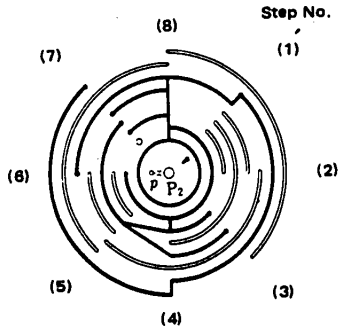

Fig. 12. Example of Development of Slotted Cam of Pneumatic Sequencer

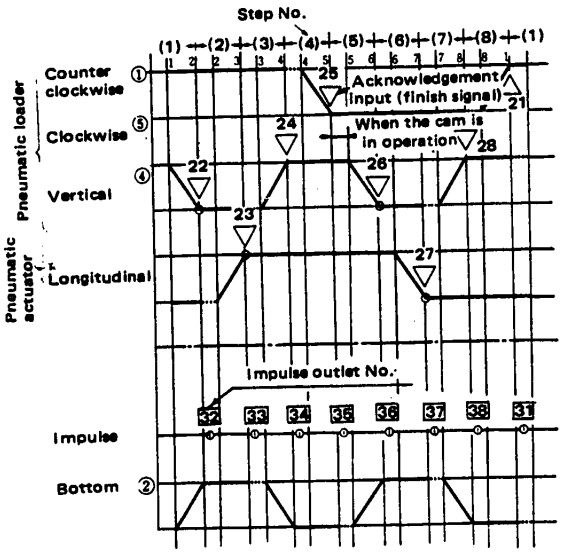

Fig. 13. Diagram of Loader

is bled off. When the sensor is closed upon the completion of loader operation, a back pressure is generated, which overcomes S_3 by stepping cylinder S_2 and drives the piston, causing 1 step to be carried out by the revolution of the ratchet on the cam shaft. In the subsequent step, the arm swivels with the loader at the top position. The moment the arm finishes swiveling the back pressure sensor carries out stepping as described above.

This pneumatic sequencer is designed to give an impulse in each step. With the impulse outlet closed, steps sequentially progress automatically. If a 1-cycle stop is required, it is only necessary to leave the concerned impulse outlet open. This impulse can be used as a start signal for index tables, etc. When indexing is complete and its input signal closes the impulse outlet, the loader is again ready for cycle opeation. In other words, the sequencer can automatically find locations where the impulse outlet is open.

In conclusion, as opposed to electronics (which are active), sequencers are easy to understand and easy to maintain because their action can be visually observed. There are undoubtedly many themes for labor saving and automation presenting themselves to many readers. So, I hope that they are eager to deal with such themes promptly, beginning with simple problems, in order to achieve good results.

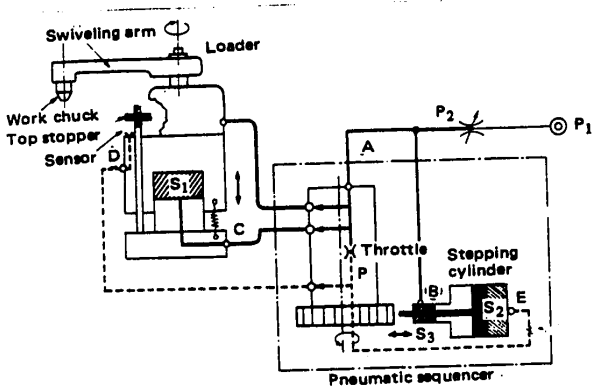

Fig. 14. Diagram of Operational Priciples for Pneumatic Sequencer

CSO: 4120/318

SCIENCE AND TECHNOLOGY

PRODUCTION OF PEPTIDES BY NUCLEIC ACID SYNTHESIS, GENE ENGINEERING

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 pp 29-35

/Article by Yoshifuma Jigami, Hideaki Tanaka and Tsutomu Nishimura, National Chemical Laboratory for Industry, Bioorganic Chemistry Division: "Production of Peptides by Nucleic Acid Syntbesis and Gene Engineering (Part II). For Part I of this article see JPRS L/9905 of 21 August 1981 FOUO 47/81 of this series pp 43-58./

/Text/

5. Production of Hetero-proteins by the Use of Synthetic Genes

We have two methods to produce hetero-proteins as gene products by inserting animals and plants genes into a microorganism. The first one is to extract m-RNA corresponding to the protein from an organism, purify it, and use double chains of c-DNA made enzymatically from m-RNA. But, in this case, it is quite difficult to isolate and purify m-RNA of the specific protein. The second is to design a gene sequence by adjusting gene codon to known amino acids sequence of the desired protein, and synthesize it organically. Making a vector for the function manifestation is an important point in making a microorganism produce hetero-proteins by using the latter method. Then, this point is illustrated by the following examples.

(1) Somatostatin[14)]

Somatostatin is expected to be used in the medical treatment of hyperpituitarism, acute hepatitis, diabetes, etc., and it is a peptide hormone composed of 14 amino acids. Figure 11 shows the outline of the cloning of somatostatin genes.

While chemical synthesis of the genes has already been described, there remain a number of problems to be examined in introducing the genes into E. coli and in expressing their functions. First, the genes are required to have the DNA sequence containing the connecting sites of RNA polymerase those of ribosome, etc., which are necessary for RNA synthesis (transcription) and protein synthesis (translation), since genetic information is transmitted as DNA→RNA→protein.

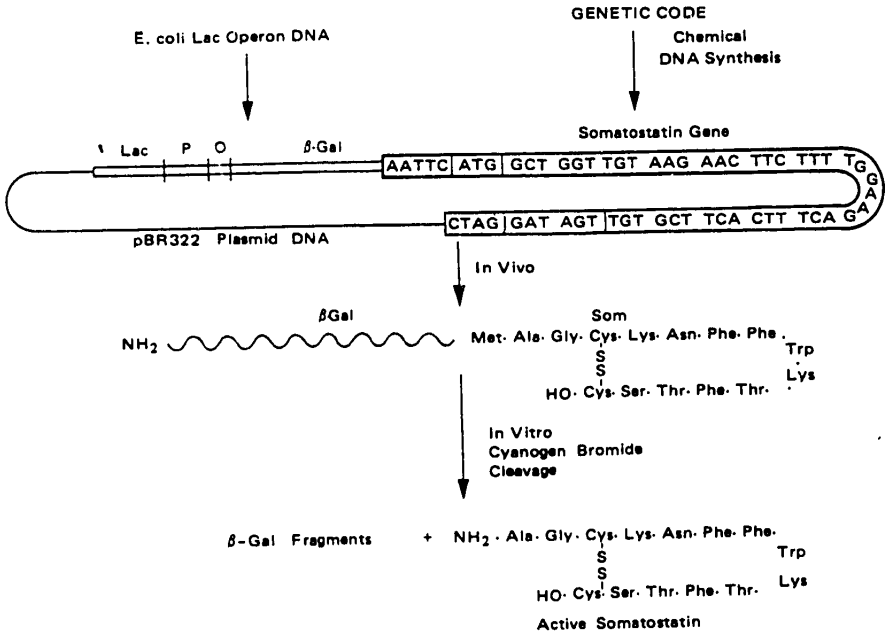

Fig. 11. Outline of Cloning of Somatostatin Gene[10)]

And, to translate m-RNA and produce active protein, the triplet corresponding to the amino acid must match that of the end-product amino acid when hetero-genes are inserted in the vector. To this end, we have developed a method to connect a part of lactose(lac) operon*[13] with pBR322, and to transcribe and translate synthetic genes under the control of lac operon. The details are as follows (Figure 12): First, when DNA prepared from special transducing phage (λ plac) containing lac operon is cleaved by restriction enzyme *Hae* III, this fragment (203 base pairs) has the promoter of lac operon, the CAP connecting site, the operator, the ribosome connecting site, and the first seven amino-acid codons of the β-galactosidase gene. The fragment is then to be inserted into the *Eco* RI cleavage site of pBR322. Here, *Hae* III cleaves double chains of DNA with no adhesive ends left, at the same position. Another *Eco* RI produces an adhesive end with 5'-end exserted, as described before. Therefore, both of them as such cannot be connected by T_4-ligase. Then, the 3'-ends cleaved off by *Eco* RI are repaired by T_4-DNA polymerase and non-adhesive ends are made. After that, they are connected, by ligase, with the *Hae* III fragment of lac operon to be complex plasmid pBH10. But, there are two *Eco* RI recognition sites in the pBH10 vector, which

are required to be unified. Vector (pBH20) is then produced with the *Eco* RI site closer to tetracycline(Tc) resistance gene left and that, closer to ampicilin(Ap) resistance gene, demolished. The following skilled method is taken for this purpose: The *Eco* RI site nearer Tc gene is protected by adding RNA polymerase to pBH10. Cleaving the site by *Eco* RI results in the ring-opening of the plasmid nearer the Ap gene. Then, the exerted adhesive end of the plasmid is broken off by S-1 nuclease, and finally the plasmid is ring-closed again. The pBH20 has an *Eco* RI site and a *Bam* HI site. The somatostatin genes synthesized in advance, so as to have *Eco* RI and *Bam* HI sites, are then inserted into those two sites. This recombinant DNA is infected with E. coli, and several transformed strains of Ap-resistant and Tc-sensitif are selected. The examination of the base sequences of the plasmids recovered from these bacteria has revealed that, in one of the plasmids(pSOMI), all the base pairs take part in the connection between lac operon and somatostatin gene, and the pSOMI coincides also with the phase of triplet to

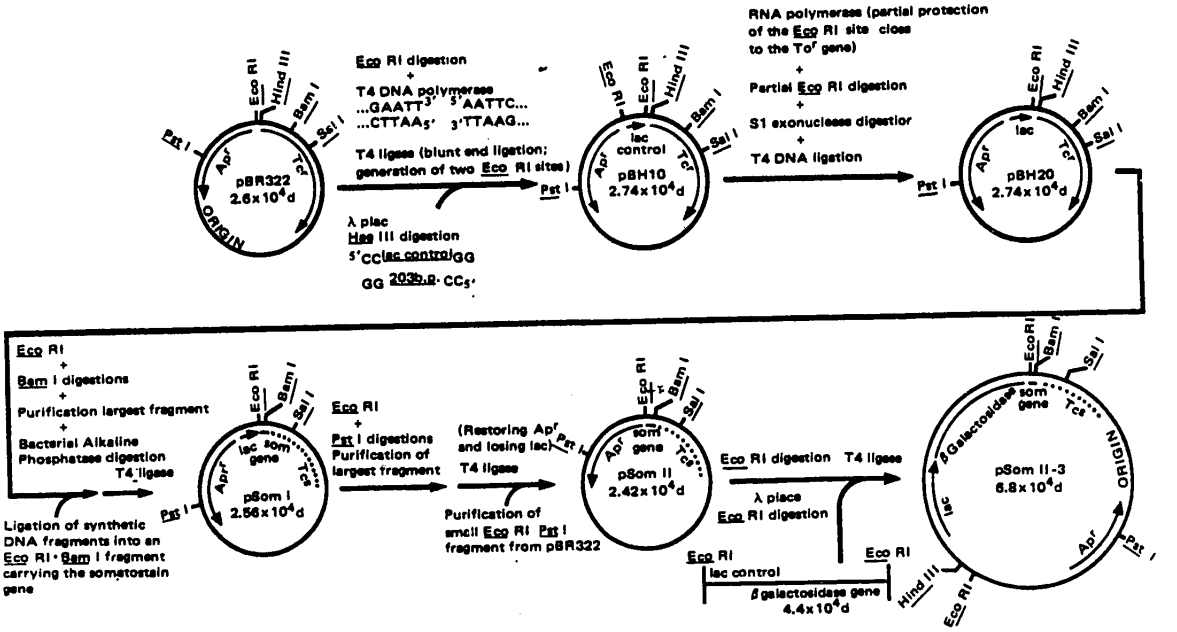

Fig. 12. Method of Production of Recombinant DNA Containing Somatostatin Gene[10)]

read amino acid codon. But, when the bacteria keeping this plasmid(pSOMI) was cultured, somatostatin was not produced either in the medium or in vivo. This result was considered to be due to the rapid decomposition, by proteolytic enzyme, of somatostatin produced in vivo, because translation into protein must have occured. Accordingly, for preventing the decomposition, it is necessary to make somatostatin with a small molecular weight stable by connecting another protein molecule with a large molecular weight to somatostatin. It has been found that β-galactosidase gene of lac operon has an *Eco* RI cleavage site close to its carboxyl end, and the sequence of the amino-acid codon is kept correct even if an *Eco* RI-*Bam* HI fragment of somatostatin gene is inserted into the *Eco* RI site. Next, such plasmid as described below has then been developed. That is, the aforementioned pSOMI is cleaved by *Eco* RI-*Pst* I and the larger fragment is recovered from gel while the lac operon is cleaved off. Connection between this fragment and *Eco* RI-*Pst* I fragment of pBR322 produces pSOM11. Further, *Eco* RI fragment of λplac 5 DNA is inserted into *Eco* RI site of this pSOM11. The complex plasmid produced thus was infected with E. coli, and some clones were examined for the presence of somatostatin produced. As the result, somatostatin activity was observed in four clones(pSOM11-3, 11-5, 11-6, and 11-7). It was confirmed, by analysis of the fragments by restriction enzymes, that lac operon fragment is inserted in the correct direction into these plasmids. On the other hand, somatostatin activity was not detected in the clones(pSOM11-2 and 11-4) into which lac operon was inserted in the opposite direction. It is evident from these facts that somatostatin synthesis is controlled by lac operon. There is a lac repressor gene on the chromosome of E. coli (Strain RR1) used in the experiment. The gene produces 10–20 molecules of repressors per cell, while the copy number of this plasmid (i.e., the number of molecules of lac operator) is 20–30 per cell. For this reason, the repression did not work completely. On the other hand, when the bacteria keeping pSOM11-3 is cultured in the presence of isopropyl-β-D-thiogalactoside (IPTG), the activity of somatostatin produced is increased (Table 1). This is due to the induction of lac operon by IPTG, however, the induction level is quite low with a level of 2.4–7.0 times.

Here, the activity of somatostatin cannot be detected by the radioimmunoassay method until the bacteria protein is treated with cyanogen bromide. This is because antiserum (S39) used in the experiment needs free N-end alanine and N-end alanine of somatostatin cannot be produced without cyanogen bromide treatment. It has also been reported that the bacteria keeping the plasmid with *Eco* RI fragment of lac operon like pSOM11-2 or PSOM11-3, is apt to loose this complex plasmid. For example, in half of the strain RR1 keeping pSOM11-3, β-galactosidase of lac operon was not constitutive and was of Ap susceptibility after 15 generations. It is inferred that instability of plasmid, independent of somatostatin activity, is attributed to the production of a large amount of β-galactosidase protein which is incomplete,

Table 1. Somatostatin Radioimmune Specific Activity[14)]

Test	Strain	Medium	IPTG 1mM	CNBr 5mg/ml	SS/protein (pg/mg)
1	11-2	LB	+	+	<0.1
	11-3	LB	+	+	12
	11-4	LB	+	+	<0.4
	11-5	LB	+	+	15
2	11-3	LB	+	+	12
	11-3	LB	+	–	<0.1
3	11-3	LB	+	+	61
	11-3	LB	–	+	8
	11-3	LB	+	–	<0.1
4	11-3	LB	+	+	71
	11-3	VB+glycerol*	+	+	62
5	11-3	LB+glycerol	+	+	250
6	11-3	LB	+	+	320
	11-2	LB	+	+	<0.1
7	11-3	LB	+	+	24
	11-3	LB	–	+	10

* Vogel-Bonner minimal medium plus glycerol.
LB: Luria broth.
IPTG: Isopropylthiogalactoside.
SS: Somatostatin

inactive, and has a large molecular weight. Extremely low yield, as 0.001–0.03% in Table 1, of somatostatin in all proteins is also due to β-galactosidase protein production in large amount, and some of the measured bacteria are considered to have contained even clones without lac operon.

(2) Insulin[23)]

Insulin is a peptidehormone with an A chain of 21 amino acids and a B chain of 30 amino acids connected by two S-S bonds, and used for medical treatment of diabetes because of it lowers blood-sugar levels. Since it is difficult to supply human insulin, that extracted from the liver of a cow or pig is now used. But, three amino acids of the cow insulin are different from the corresponding amino acids of human insulin, and in the case of pig, one amino acid is different from that of human insulin. Side effects, as production of antibody and allergy, consequently occur when insulin from cow or pig is used for an extended period. Research for making a microorganism produce a large amount of human insulin by gene engineering has been made. Chemical synthesis of insulin gene has been described above. This cloning has been done for each A chin and B chain. Therefore, active insulin cannot be prepared until A chain peptides are connected with B chain peptides in vitro. The method of cloning is almost the same as that in somatostatin stated previously. Figure 13 illustrates the method to produce a complex plasmid containing B chain gene. *Hind* III cleavage site is inserted into nearly the middle of the synthetic B chain gene see Figure 9). While a long B chain of genes is synthesized in halves, separate pieces are connected with

vector. It being amplified, DNA in large amount is recovered, and it is confirmed by *Hind* III cleavage site inserted, that DNA base sequence is correct. To put it concretely, plasmid pBB101 is first prepared with *Hind* III-*Bam* HI fragment(BB) corresponding to the right half of the B chain gene being inserted into *Hind* III-*Bam* HI fragment of pBR322. When the pBB101 is cleaved by *Eco* RI-*Hind* III, and the larger fragment is separated and purified by the use of 10% acrylamide gel electrophoresis, BB is connected with pBR322 at *Bam* HI site and recombinant DNA with adhesive ends of *Eco* RI and *Hind* III is recovered. In the same way, plasmid pBH1 is produced with *Eco* RI-*Hind* III fragment corresponding to the left half of the B chain genes being inserted into pBR322. Then, the plasmid is cleaved by *Eco* RI-*Hind* III and the smaller fragment is recovered from gel this time (BH). When both DNA fragments are connected, by ligase, together with λplac 5 DNA treated with *Eco* RI and the reaction product, as such, is infected with E. coli (Strain 294), only the bacteria having recombinant DNA with the correct sequence, (i.e., connection in BH-BB order) can be grown. Because the connection with *Eco* RI fragment of λplac 5 is attained, *Eco* RI site is then made only when *Hind* III sites of BH and BB+pBR322 are correctly connected.

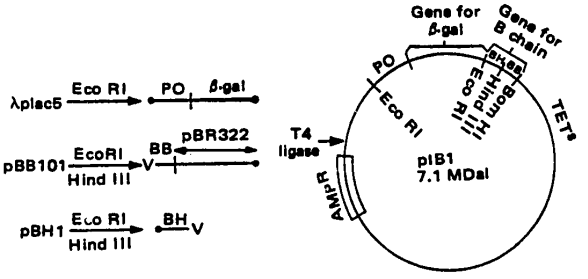

Fig. 13. Production Method of Recombinant DNA's Containing Insulin B-chain Gene[11)]

The plasmids of pIBI and pIAI*[14] have been replicated inside E. coli (Strain D1210 and Strain 294), at the same time transcribed in m-RNA, and further translated into protein. The products of insulin A chain and B chain in connection with β-galactosidase amount to about 20% of all bacteria protein. However, the complex protein is insoluble in water, and recovered in precipitate fractions by low-speed centrifugation. Insulin B chain is purified from bacteria as follows:

Once the Strain D1210 keeping pIBI is cultured up to the latter logarithmic phase on the LB medium containing ampicilin, another generation is grown with the addition of isopropyl-β-D-thiogalactoside (IPTG) in 2mM final concentration.

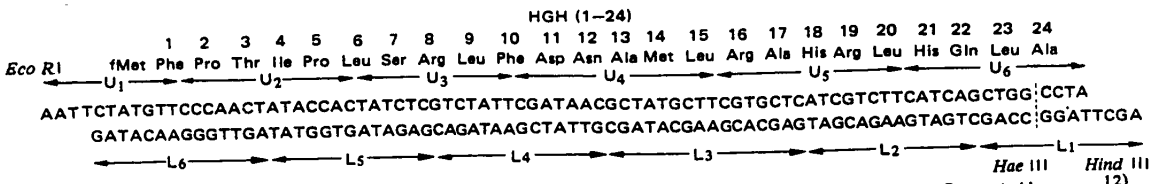

Fig. 14. The Base Sequence of Genes Corresponding to Amino Acids for the 1st to 24th Human Growth Hormone[12)]

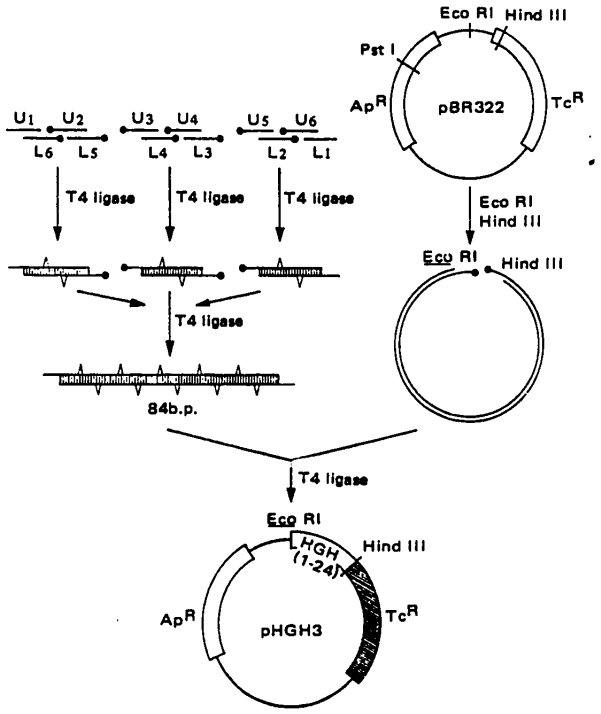

Fig. 15. The Transformation Method of Chemically Synthesized DNA Fragments of Human Growth Hormone into the Plasmid[12)]

Table 2. Reconstitution of Radioimmune Human Insulin

"A" sample	"B" sample	Radioimmune active insuline (ng)
E. coli 58-HPLC*	–	<0.5
–	*E. coli* DE117†	<0.5
Porcine A‡	*E. coli* DE117	74
E. coli 58-HPLC	Bovine B§	45
E. coli 58-HPLC	*E. coli* DE117	20

* 500μl of fraction 58 from an aminoethyl-cellulosecolumn was chromatographed on an RP-8 column and the A peak was collected. As estimated from the peak height, the sample contained approximately 25μg of protein.
† Protein was contained in 10μl of DEAE-cellulose fraction 117.
‡ S-sulfonated porcine A (70μg)
§ S-sulfonated insulin bovine B (10μg)

Owing to this, transcription of lac operon is induced and greater amount of insulin B chain peptides connected with β-galactosidase is produced. The bacteria are concentrated and crushed. The crushed bacteria solution is centrifuged and the resultant precipitate is dissolved in 40ml of 6M hydrochloric acid guanidine/1% 2-mercaptoethanol. As the solution is ultracentrifuged, the complex insulin protein is recovered in 70% formic acid and treated with cyanogen bromide, the results in the precipitation of the protein. This being dissolved in 70% formic acid and treated with cyanogen bromide, insulin chain connected with β-galactosidase can be broken at the methionine site and liberated. Free insulin B chain is dissolved in 8M hydrochloric acid guanidine, and S-sulphonated so that B chain with a mixture of A chain can produce active insulin. The sulphonation is realized by reaction with $Na_2S_2O_6$ and Na_2SO_3 at pH 9 and room temperature for 24 hours. After the pH of S-sulphonated peptide is adjusted by acetic acid, it is dialyzed twice against distilled water. It is further purified by DEAE-cellulose column chromatography, high-speed liquid chromatography, and reversed phase chromatography.

Mixing S-sulphonated insulin A and B chains isolated and purified by the above method produces active insulin whose activity can be examined by the radioimmunoassay method (Table 2). The results showed that 10mg of insulin chain was produced while 24g of wet bacteria were used. This yield is 10 times as much as that of somatostatin.

(3) Human Growth Hormone[24)]

Human growth hormone (HGH) is a protein with 191 amino acids synthesized in pars distalis hypophysis. While the so-called dwarfism occurs through the deficiency of the genes responsible for the hormone synthesis, the hormone is prescribed in infancy for its medical treatment. But, the effects of this hormone are specific for men and growth hormone from other animals cannot be substituted for HGH. The only source of its supply is now corpse, and mass

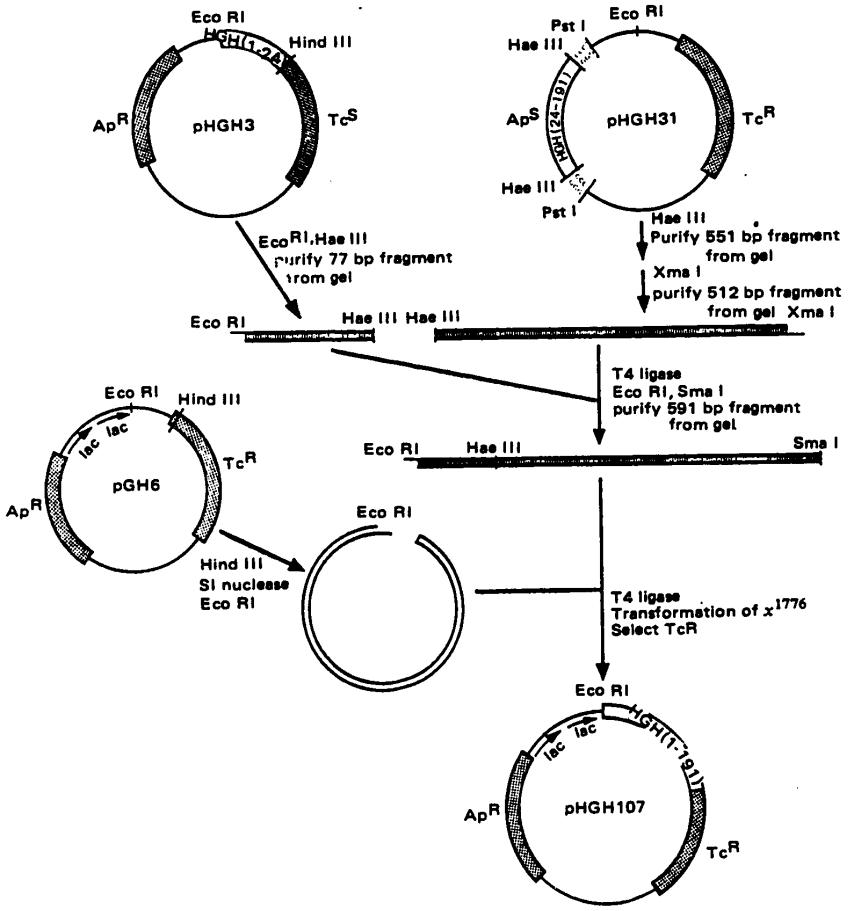

Fig. 16. The Formation Method of Recombinant DNA Containing Human Growth Hormone Gene[12]

production of HGH is difficult. The mass production by gene engineering has been planned. A procedure is as follows: It has been known that this hormone is translated from m-RNA coding a precursor of protein with 26 amino acids in excess at the N-end. Also, the cleavage patterns, by restriction enzyme, of c-DNA prepared from this m-RNA by using the reverse transcriptase has also been reported. According to this, *Hae* III cleavage sites exist at 3'-end region coding for non-amino acids and the part coding of the 23rd and 24th amino acids of HGH, in c-DNA of HGH. DNA fragment with 551 base pairs corresponding to the amino acids from the 24th to the last 191st can be then supplied

by *Hae* III cleavage of HGH c-DNA double chains. Therefore, the remainder (i.e., the gene corresponding to the first through twenty-third amino acids) are required to be prepared separately. These parts of DNA are to be synthesized chemically. That is to say, the first through twenty-third amino acids of HGH and the gene with initiator codon of ATG at the 5'-end are chemically synthesized. This being connected with the front of c-DNA prepared from an organism, a complete HGH gene is produced.

If the HGH gene is inserted into the promoter (which is necessary for the transcription of m-RNA) of a suitable micro-organism (E. coli) and the downstream (3'-end side) of vector containing ribosome connecting site (which is necessary for initiation of protein synthesis), the recombination DNA must produce HGH protein with f-Met at the starting point, after transcribed in m-RNA. Then, the f-Met is expected to be cleaved off in vivo since microorganism protein has no methionine at the N-end. HGH with the desired sequence of amino acids must be then produced as a free form.

The method to use both c-DNA in vivo and synthetic DNA has been adopted on the basis of the above strategy. This method has several advantages compared with the ordinary method to use only c-DNA or synthetic DNA. First, in the case of cloning by the ordinary c-DNA method, the end product protein is produced in connection with the protein made on the basis of the genes on vector (complex protein). But, it is very difficult to cleave this complex protein, specifically, at the connecting site. And, even if the desired protein is produced while liberated from the vector protein, the protein obtained by the c-DNA method is a precursor of the active protein. The product, in the case of HGH, becomes an active protein with 26 amino acids, in excess, at the N-end. On the other hand, the method to use synthetic DNA does not have these defects, however, it is difficult to synthesize the genes corresponding to a polypeptide with a large molecular weight. In the HGH case, since it contains 191 amino acids, 573 base pairs (threefold of 191) are required to be synthesized at the DNA level, and the synthesis takes a long time. A skillful method to cover up the defects of both methods is that described before. The details are introduced below.

The base sequence of a gene at the N-end (24 amino acids) of synthetic HGH is shown in Figure 14. Subsequent connection with c-DNA considered, *Hae* III cleavage site ($^{5'}$GGCC$^{3'}$) is left at the part extending over the 23rd and 24th. And, adhesive ends of *Eco* RI and *Hind* III are made at the 5'- and 3'-ends, respectively, so that connection with vector (pBR322) broken by *Eco* RI and *Hind* III can be attained. Figure 15 illustrates the methods to connect synthetic DNA fragments and insert them into vector. This complex plasmid is transformed into E. coli (Strain 294), and three strains of bacteria incorporating recombinant DNA with synthetic DNA inserted, are obtained. When these plasmids are recovered and their base sequences analyzed, a strain of bacteria keeping the plasmid (pHGH3) with the objective DNA sequence is found. For some unknown reason, two remaining strains are devoid

Table 3. Radioimmuno Activity of Human Growth Hormone [24]

Strain	Cell density (cells per ml)	Quantity of human growth hormone (μg per ml)	Copy number of human growth hormone per cell
X1776/pHGH 107	3.69×10^8	2.4	186,000
	1×10^9	1.4	39,000
X1776/pHGH 107-1	3.6×10^8	1.5	116,000
	1×10^9	0.5	14,000
X1776/pBR 322	3.6×10^8	0	0
D1210/pHGH 107	3.8×10^8	1×10^{-4}	15
D1210/pHGH 107 (IPTG)	3.8×10^8	1.0	75,000

of the third base pair (A:T pair) of the fifth amino acid (proline) codon. On the other hand, preparation of c-DNA originating from an organism and its connection with a vector are skillfully attained by the use of the Terminal transferase method shown previously in Figure 5. However, the details are omitted.

All materials for cloning are thus prepared, and the HGH production process now enters into the final stage of connecting three DNAs. Figure 16 shows its outline. DNA fragment with 77 base pairs, containing synthetic genes, is recovered from pHGH3 cleaved by *Eco* RI *Hae* III. On the other hand, from pHGH31 broken by *Hae* III and subsequently by *Xma* I, a 512 base-pairs DNA fragment containing codons corresponding to the 24th-191st amino acids is recovered. Next, both of them are treated with ligase, and 591 base pairs with all sequence of HGH are recovered. On the other hand, vector pGH6 is cleaved by *Hind* III, and pGH6 by *Eco* RI while the excised 3'-adhesive end are broken off by S-1 nuclease. HGH DNA and the vector are then connected at the *Eco* RI (adhesive end) and *Sma* I (non-adhesive end) sites, through ligase treatment, and they become the end product plasmid (pHGH 107).

When this plasmid is transformed into E. coli (Strain X1776) and selected by Tc resistance, growth of the clone means completion of the translation by reading through the lac promoter, the HGH gene and the Tc gene.

Four hundreds of transformants are obtained by primary selection, further limited to 12 Strains by hybridization on filter, and identified with the end product plasmid.

Incidentally, in this plasmid (pHGH107), the initiator codon ATG of HGH gene is at such a distance from the ribosome connecting site, AGGA, of lac operon that 11 base pairs, with the adhesive end, AATT, of *Eco* RI amid them, are interposed between ATG and AGGA.

5' . . . A G G A A A C A G A A T T C T A T G . . .
3' . . . T C C T T T G T C T T A A G A T A C . . .

On the other hand, in the lac operon of E. coli, there are only seven base pairs between those.

5' . . . A G G A A A C A G | C T A T G . . .
3' . . . T C C T T T G T C | G A T A C . . .

Then, the plasmid with the correct sequence of lac operon was also produced. For that, pHGH107 produced previously was cleaved by *Eco* RI and excised, and part of the single chain was broken off by S-1 nuclease. Then, closing it again by the non-adhesive end, produced the plasmid (pHGH 107-1) with new *Alu* I site and no *Eco* RI site. In this plasmid, initiator codon (ATG) of HGH is seven base pairs downstream from the ribosome connecting site, which is consistent with that of the organism. Hence, translation into protein was expected to be done more efficiently than in the previous case of pHGH107.

Actual examination of HGH activity by radioimmunoassay has revealed that either of the bacteria with plasmid pHGH107 or pHGH107-1 have striking HGH activity (Table 3). But, contrary to expectation, larger amount of HGH (per cell) is produced in the pHGH107 case than in the pHGH107-1 with the same sequence as lac in vivo. And, this experiment has also revealed that the production of HGH is under the control of the lac operon. That is to say, in a mutant (Strain D1210) of E. coli K12 Strain HB101 overproducing lac repressor, while lac operon did not work, no HGH was produced. But, when this bacterium was cultured in the presence of IPTG, a lac operon inducer, lac operon worked and HGH was then produced (Table 3).

Moreover, it has also been reported that the yield of HGH is considerably dependent on the medium used or the time for culture. It is said that 186,000 molecules, per cell, of HGH protein can be produced by using a nutritious medium such as LB and recovery of bacteria in the logarithmic phase. The yield is low if the bacteria is grown in minimal media or at the resting stage. As a consequence, the metabolic circulation of HGH protein inside the bacteria is conceivable.

6. Afterword

The method to manifest foreign-DNA in a microorganism has made rapid progress for the past several years as described above. But, the manifestation of higher-organism genes inside a microorganism involves serious problems and it is extremely difficult to extract the desired genes from a higher organism and purify them. In the case of gene engineering applied to the production of materials in the chemical industry, it is also necessary, for production efficiency, to use purified DNA. Fortunately, the relation between DNA base sequence and amino acid has been clarified and the synthesis of nucleic acid oligomers has become possible through application of the triester method and others. Moreover, manifestation of DNA, obtained inside E. coli by enzymotic oligomer linkage, has offered a promising prospect for applying this technique

to the production of materials in the future. An ingenious device and a good idea are required, as described in chapter 5, to manifest synthetic DNA in a microorganism.

Notes:

*1) This is called a vector in making recombinant DNA; and a plasmid or a phage is used.
*2) A and G are called purine base, and C, T, and U pyrimidine base.
*3) Enzyme 1st found in Escherichia coli R.
*4) Enzyme 3rd found in Haemophilus in fluenzae d.
*5) Enzyme 1st discovered from Providensia stuartii.
*6) This is called transformation.
*7) dC indicates 2'-deoxycytidine, and dG 2'-deoxyguanosine.
*8) This operation is annealing.
*9) Gene producing an enzyme participating in the biosynthesis of leucine.
*10) Mutant that cannot grow because of deficiency of the leucine gene unless leucine is added to the medium.
*11) This is a probe.
*12) The glucoside bond of deoxyribonucleoside is less stable to oxyhydrolysis than that of ribonucleoside. Specially, that of N-acyladenine is least stable to acid. Deprotection of these protecting groups is possible in concentrated aqueous ammonia. The groups are stable to condition of acid treatment during condensation.
*13) Cluster of a few kinds of genes producing an enzyme digesting lactose. The gene cluster going through the common transcription regulation is called operon.
*14) Plasmid with lac operon correctly inserted. The plasmids with A chain and B chain are called pIAI and pIBI, respectively.

(By courtesy of the National Chemical Laboratory for Industry)

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CSO: 4120/318

SCIENCE AND TECHNOLOGY

GaAs MONOLITHIC IC LOW-NOISE WIDE-BAND AMPLIFIER COVERING FROM VHF TO UHF BANDS

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 pp 36-40

/Text/

Matsushita Electric Industry Co. has succeeded in development of the GaAs monolithic IC low-noise wide-band amplifier covering from VHF to UHF bands. In detail, this IC is as follows.

1. Introduction

The gallium arsenide (GaAs) semiconductor is expected to be used much in the future as a material with superior high frequency characteristics that silicon (Si) can not reach. The biggest feature of GaAs is that electron mobility (easy moving of electrons) in semiconductors is about six times better than that in Si. The field effect transistor (FET) using GaAs can show its excellent performance in higher frequency than the Si FET. The GaSi FET has already had practical application mainly for microwave communication equipment as the transistor that allows the realization of superior noise-reduction and gain in the high frequency band over 2 GHz. The plastic molded GaAs dual-gate FET (brand name 2SK97) that was developed last year for the purpose of introduction to consumer equipment for UHF band has already been applied practically in TV tuners and it is now under mass production.(1)(2)

With the background of this practical success of the discrete FET, it has recently been found that the movement to produce high frequency and high speed monolithic IC's is getting active. The reason is that GaAs has another big feature which is that it enables fabrication of a semi-insulating single crystal substrate. In other words, if integrated circuits are configured on this semi-insulating GaAs substrate, parasitic capacitance, which is a big problem for high frequency, can be made very small like hybrid IC's on dielectric insulating substrate or silicon on sapphire (SOS). This allows the fabrication of high speed and high frequency monolithic integrated circuits.

With the recent progress of fine pattern technology, extensive efforts have been made for high frequency in the Si monolithic IC, but it is still considered that the range from almost 300 to 500MHz is the frequency limit of the Si monolithic IC. On the other hand, the demand for the monolithic high frequency circuits covering from VHF to UHF in the range of 1000 to 2000MHz has been very strong with a view to small and lightweight equipment, low voltage operation, low power consumption, or simple circuit adjustment in boosters or tuners used in VHF-UHF consumer equipment such as TV's or VTR's. We have succeeded in the development of the lowest noise GaAs monolithic wide-band amplifier in the world. This amplifier covers the area from VHF to UHF bands as the first monolithic linear IC and its noise figure (NF) is 1.7 to 2.2dB over the band from 50 to 2000MHz.[3] The wide-band low noise amplifier is a very basic and important circuit and it can be exploited for various applications. The following is a more detailed description of this IC:

2. Organization and Design of IC

Generally, a high-frequency amplifier makes the reflection coefficient at an input/output port as small as possible and it is therefore necessary to design for matching I/O impedance of the amplifier to signal and load impedance. There are many methods to design a wide-band amplifier that performs impedance matching over a wide frequency range. One of them is to drive negative feedback from the collector to the base by resistance in bipolar transistor circuits. This is a well-known method to drive negative feedback from the output to the input side for creation of a wide-band so that a frequency with larger gain may get smaller beedback. The new development has manufactured for trial uses a negative feedback amplifier with the GaAs monolithic IC's and it has realized the performance as shown in Table 1. In general, wide-band matching is implemented by a combination of an inductor and a capacitor to match I/O impedance of an amplifier to signal and load impedance (normally 50Ω in high frequency). However, for the GaAs FET, this matching method requires very complicated circuits because it is particularly difficult to achieve matching over the wide-band in the frequency range below 2GHz. In the range from VHF to UHF bands, the wave length becomes considerably long and the circuit dimensions also become large. It is not suitable for the circuit organization of monolithic IC's to cover the above frequency range.

Table 1. Performance of GaAs Monolithic IC Super Wide-Band Low Noise Amplifier

Item	Performance
Band width	50～2000 MHz
Noise figure	1.7～2.2 dB
Gain	10～8 dB
Input/output VSWR	2.5
Gain reduction	−25dB
Operating voltage	3～5 V

Fig.1 shows the circuit organization of the new GaAs monolithic IC wide-band amplifier. In these monolithic IC's, only the high frequency circuits are made integrated circuits, as shown in Fig.1, with the exception of the DC bias circuits. The reason why the bias circuits are excluded is because (1) the chip size can be made small and (2) outer mounting of them can be simply performed. Rf is a feedback resistor and cf is a condenser for cutting DC. The amplifier IC's using the dual-gate FET's as shown at (B) in Fig.1. are made to have a gain reduction feature. The chip is molded in a normal ceramic package as shown in Fig.2.

Feedback Resistor Rf and Mutual Conductance Gm are designed for maintaining the I/O coefficient below-10dB and gain over 8dB from a computed result based on a simple equivalent circuit. Fig.3 is a computed result to show the relationship among Gm, Rf, I/O coefficient ($|S_{11}|$, $|S_{22}|$) and gain ($|S_{21}|$) of the amplifier. Based on this result, 100ms is selected as Gm and 300Ω as Rf. Fig.4 is an outline of a wide-

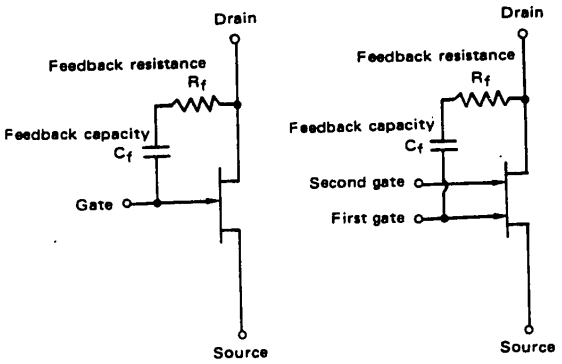

Fig. 1. Circuit Organization

[Figures 2 and 4 not reproduced]

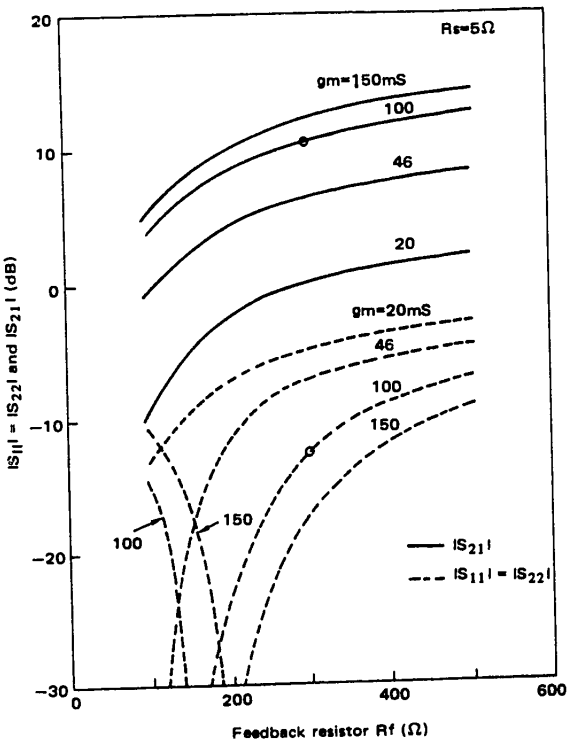

Fig. 3. Feedback Resistor *vs*. Input/Output Reflection Coefficient and Gain Characteristics

band amplifier chip fabricated for trial. The chip size is 0.65 x 0.60mm. The FET is designed for a total gate width of 1000μm by parallel connection of ten gate strips having a width of 100μm. The gate length is 1μm. The structure model of this IC is shown in Fig.5. As shown in the figure, Feedback Resistor Rf is formed on the epitaxial layer isolated in the shape of an island from the FET part on the high resistance GaAs buffer layer. The resistance value is controlled by thinning the thickness of the epitaxial layer through chemical etching. Condenser Cf to block Dc current is configured by using backward capacitance of Schottky diodes in order to make the most effective use of the chip area. The capacity is about 50pF and the junction cross section is 9×10^{14} cm^2, The Schottky metal for gates is chrominum, platinum, or gold and the ohmic metal for source and drain is gold-germanium or gold. The wiring metal is titanium or gold.

3. Performance and Features of IC

The frequency characteristics of the gain and NF of the wide-band amplifier that was manufactured for trial as above is shown in Fig.6. The NF is below 2.2dB in 50 to 2000MHz and below 1.7dB in the range particularly of 200 to 600MHz. The gain is 8 to 10dB over the range of 50 to 2000MHz. The lower NF and wider band are realized. The NF increases below

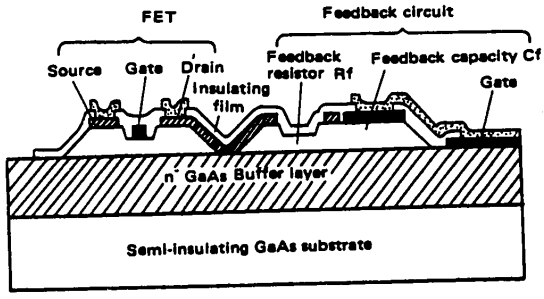

Fig. 5. A Sectional Outline of GaAs

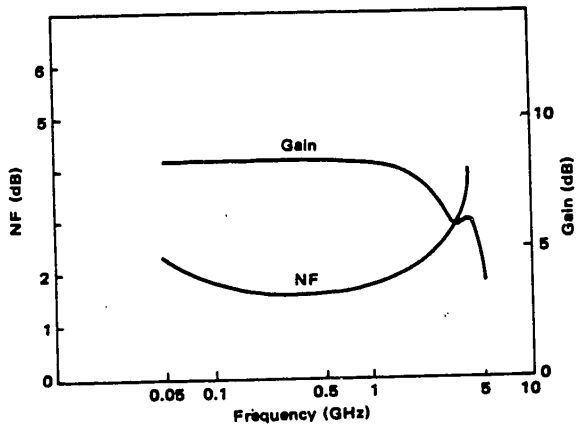

Fig. 6. Frequency Characteristics of Gain and NF

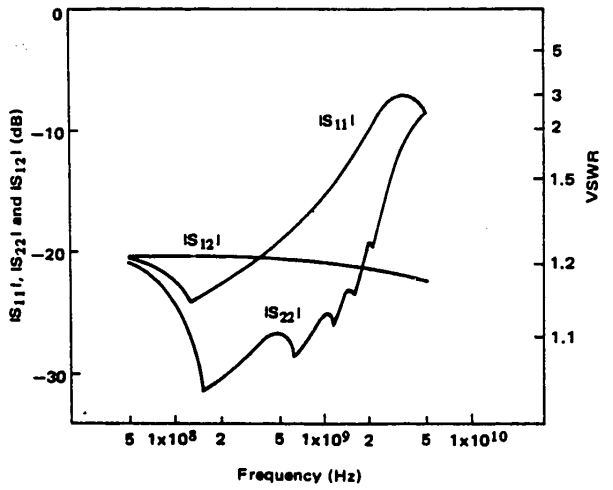

Fig. 7. Frequency Characteristics of Input/Output Reflection Coefficient and Isolation

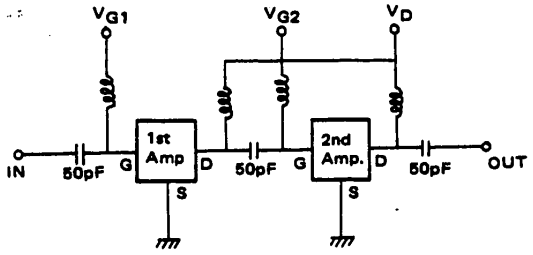

Fig. 8. Multistage Connection Circuit Diagram

the frequency range below 200MHz because I/f noise appears. Fig.7 shows the I/O reflection coefficient ($|S_{11}|$, $|S_{22}|$) of the amplifier IC and the frequency characteristics of isolation ($|S_{12}|$). The I/O reflection coefficient is below-10dB (USWR-Voltage Standing Wave Radio – <2.5) and so is very small. Thus, if multistage amplifiers are built with no matching circuits between stages, one stage gain or an addition of isola-

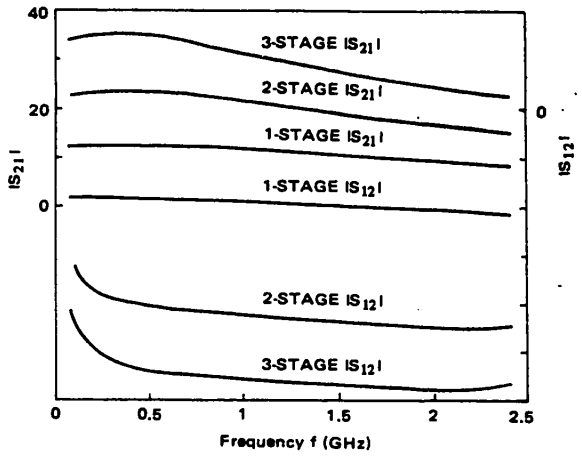

Fig. 9. Frequency Characteristics of Gain and Isolation at Multistage Connection Time

tion characteristics to multistages can be obtained. Fig.9 shows gain, and isolation characteristics at the time of one-, two- and three stage connection. The I/O reflection coefficient at multi-stage connection time is almost the same as at one-stage.

Fig.10 shows an example of Input/Output, 2nd and 3rd distortion characteristics of the amplifier IC. The I/O characteristics were measured at 200MHz and the 2nd distortion output was at f_0=110MHz for f_1=200MHz and f_2=90MHz. The 3rd distortion output was measured at f_0=210MHz for f_1=200MHz and f_2=190MHz. The 2nd and 3rd distortion outputs for fundamental output 0dBm are −50dBm and −80dBm, respectively. Both of them are very superior distortion characteristics. The characteristics of both input/output and distortion depend on drain voltage V_{DS} and drain saturation current I_{DSS}. The bigger the I_{DSS} and V_{DS}, the bigger the output and the more superior the distortion characteristics obtained. Fig.10 is an example if V_{DS} is 3V and I_{DSS} equals 100mA.

For the negative feedback amplifier IC using the dual-gate FET (as in (b) of Fig.1), a 25dB gain can be controlled by putting DC voltage on the second gate. For the dual-gate FET amplifier IC, the NF, gain, and I/O Voltage Standing Wave Ratio (VSWR) were almost the same as those of the single-gate FET amplifier IC.

The following is a summary of the featured of the GaAs monolithic IC wide-band amplifier:

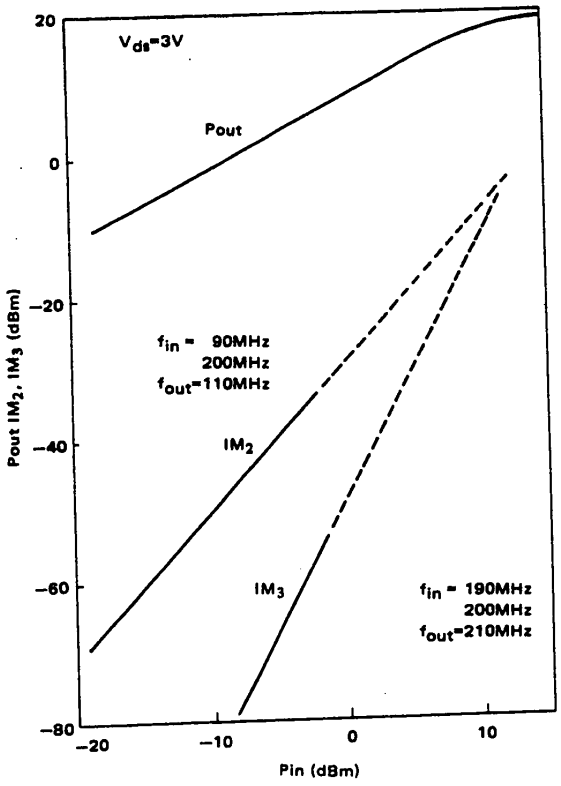

Fig. 10. Input/Output and Distortion Characteristics

(1) As the monolithic IC amplifier convering from VHF to UHF bands, its noise figure is 1.7 to 2.2dB, which is the lowest in the world.
(2) Input/output impedance is matched to 50Ω over the super wide band of 50 to 2000MHz.
(3) High gain can easily be obtained by multistage configuration.
(4) Superior in 2nd and 3rd distortion characteristics.
(5) Gain can be controlled in the dual-gate FET amplifier IC.
(6) Low voltage operation is possible.
(7) Compact and lightweight.

This wide-band low noise amplifier IC (MEL 7050) is expected to contributs greatly to compactness, lightness of weight, and low voltage operation of tuners used particularly for TV's and VTR's owing to the abovementioned superior features.

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SCIENCE AND TECHNOLOGY

TRIAL SALES OF BLUE LED'S TO BEGIN

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 pp 40, 41

/Text/

Matsushita Electronic Industry Co., Ltd. will start deliveries of samples of blue LED's (Light Emitting Diode) from this autumn. This is the GaN blue LED newly-developed by Matsushita Research Institute Tokyo, Inc., and has a light-emitting efficiency of 0.03% (power efficiency) and brightness of 2 mcd with an operating voltage of 7.5V (current of 10mA).

The RCA Laboratory of the U.S. and LEP of France have already put forward blue LED's of the GaN type. Also Siemens has announced their SiC-type LED, with a quantum efficiency of 0.04%. However, until now both types of the LED could not be put to practical use because of the extreme difficulty in both cases, of creating the device crystal. The GaN LED developed this time by Matsushita provides good reproducibility and can be produced in quantity, though with a lower efficiency by 1 digit or more as compared with the red or green LED's.

Matsushita's GaN LED employs an MIS structure as shown in Fig.1. The GaN film of (0001) orientation is epitaxially grown on the sapphire substrate surface of (0001) orientation. However, since the lattice constant of GaN is different from that of the sapphire substrate by approximately 30%, it is rather difficult to place film of good crystallization on the sapphire substrate by simple epitaxial growth of GaN film. With this in mind, Matsushita say that high-quality crystals with largely decreased crystal defects, such as pits or rearrangements, can be grown with good reproducibility by heat-treating the sapphire substrate at high temperature.

The epitaxial growth is executed by chemical vapor deposition, whereby NH_3 and HCl gases are allowed to enter the reaction tube and then Ga on the board is placed in the

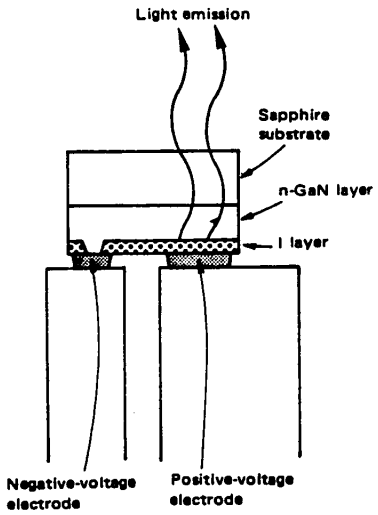


Fig. 1. Cross-sectional Structure of GaN Blue LED with Facilitated Electrode Extension

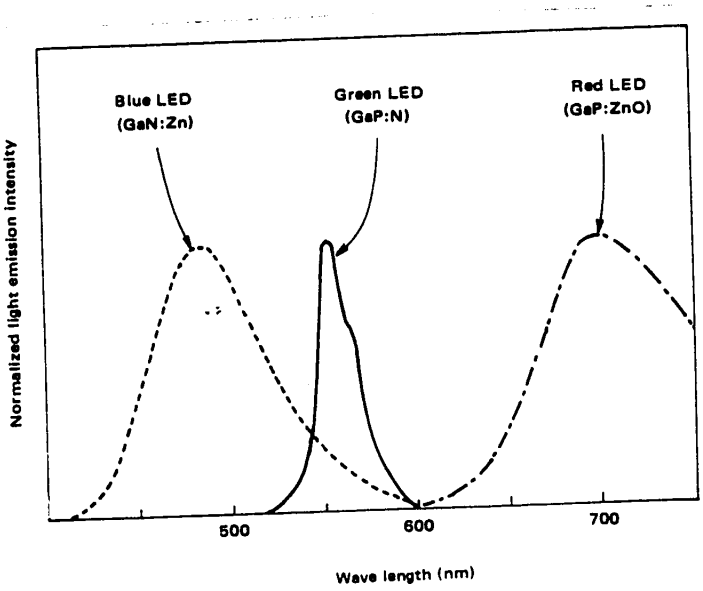


Fig. 2. Wavelength of GaN LED, Including Those of Green and Red LED's of GaP Devices as Reference

reaction tube at approximately 1,000°C. Firstly, the GaN film is allowed to grow several times 10μm in thickness without impurities, whereby making the film of an n-type semiconductor, in which the empty lattice points produced by a nitrogen deficiency act as the donor. Next, on this n-type layer, the insulator layer (I) is permitted to grow as thick as approximately 0.2μm. At this time Zn is doped as an impurity, though not sufficient to fill up the nitrogen deficiency, to convert the device into a p-type semiconductor. And finally the aluminum-based electrodes are formed on the surface.

The size of this LED chip is 720x550μm^2 with a thickness of 550μm. The brightness is 2 mcd at an operating voltage of 7.5V at operation in temperatures for −25 through to 80°C. With a peak light-emitting wavelength of 490nm, the light-emitting wavelength band is extended to the green side, appearing brighter than it really is though sufficient to be blue of high purity. However, this LED still requires a rather high voltage for its operation, which at present differs considerably from that required for red and green LED's making it difficult for it to be used together with them in, for example, in bar graphs. For this reason, future efforts will be directed towards decreasing the voltage necessary, as well as improving efficiency and brightness.

CSO: 4120/318

SCIENCE AND TECHNOLOGY

RESEARCH, DEVELOPMENT PROJECTS TO BE SUBSIDIZED LISTED

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 pp 41-43

/Text/

Following is a list of themes which have been selected as important by MITI and to be researched and developed this year.

MITI has decided to subsidize these studies because they are in fields so far unexploited and not practical commercially for investigation by private enterprise.

By reviewing these themes, the present direction of R&D in Japan will be understood.

Optelectronics

(1) Formation of elements for optical integrated circuits including growing of functional crystals and new methods of processing.
(2) Materials for optical memories – including recording materials for optical memories using laser light.
(3) Ultrasonic optical elements – those which permit correlative operation, spectral analysis, etc., using ultrasonic or superficial ultrasonic waves compatible with technology for optical integrated circuits.
(4) Functional lasers – semiconductor lasers which are able to control beams by directly applying control currents.

Advanced Measuring Technology

(1) Sensors for real-time measurement of the human body:
Among conventional types of biomeasurement, great difficulty is encountered in real-time measurement for blood tests. Since real-time biomeasurement, if realized, will not only improve the performance of central patient monitoring systems but will also reduce time for testing and diagnosis, it is desirable to develop sensors which are capable of real-time measurement of human body conditions.

(2) Microcomputers incorporating advanced measuring systems – single or composite integrated sensors which are to be used in combination with microcomputers.
(3) Advanced measuring methods which apply biological sensory functions – methods and equipment which partly provide biological sense, visual, aural, tactile, nasal or oral senses or combinations the above.
(4) Multidimensional measuring technology – methods and equipment which measure objects with planary, stereoscopic or temporal extension or objects related to multidimensional information, and which obtain required data by organic processing of data systems.

Technology for Wide Utilization of Carbon

(1) Technology for manufacturing fibers: To carbonize acryl fibers made by the present methods would cost too much to allow wide application. Thus, technology for manufacturing fibers directly from coal tar pitch, as a less expensive and high-performance manufacturing technique, is required.
(2) Technology for compacting and combining carbon materials: High-strength materials and fibrous materials represented by carbon fibers can be combined to make composite materials with higher strength.
(3) Technology for making thin films: There are several methods available for manufacturing films, such as plasma ion beam vapor deposition, spattering, and ion plating. Basic studies are also being conducted for carbon films. Here research and development concentrates on technology for manufacturing films of amorphous, diamond and graphitic structures.
(4) Technology for manufacturing diamonds by sintering – without using any metal binder. In detail: research and development of starting materials and of large ultra-high-pressure systems for sintering multicrystal bright diamonds.

Technology for Utilizing Enzymes and Microbes

(1) Manufacture and utilization of medical enzymes by making use of tissue culture: Although enzyme therapy is expected to be effective in dealing with diseases which are hard to cure by chemical therapy, available enzyme drugs are few and most of them are difficult to mass-produce. As a solution to this difficulty an attempt has been made to manufacture medical enzymes by explanting animal cells, and it may also be possible to manufacture physiologically active substances such as hormones, immunity substances and interferons by making use of explantation. Research, aims to establish technology for manufacturing medical enzymes by culturing tissues of animal and vegetable cells or microbes, while covering the following: a) basic techniques for controlling environments for explantation, b) techniques for selecting and improving productive cells such as medical enzymes, and c) techniques for indentifying, refining and condensing medical enzymes, etc.

(2) Utilization of microbes which are allowed to grow in special environments: This requires the promotion of studies on high-pressure and high-temperature resistant microbes, in addition to the conventional studies on high-salt resistant microbes which have already been conducted. Thus, the research here covers studies on: a) microbes which can live in special environments and which produce new antibiotics or physiologically active substances; b) removal of pollutants by making use of high-pressure resistant and high-temperature resistant microbes, c) application of the pressure-resistant and salt-resistant functions of microbes to artificial membranes, d) systems for high-pressure or high-salinity culture of pressure-resistant and salt-resistant microbes, and, e) application of study results in industries.

(3) Systems and applications of biological cells: The mechanisms of biological energy conversion systems mainly consist of oxidizing and reducing enzyme reactions, and may be called electrochemical reactions. Thus, it is considered possible to form cell systems by combining appropriate substrates and enzymes. In addition, enzyme reactions are so highly selective in respect to substrates that it is hoped to apply enzyme reactions of biological energy conversion systems to sensors for measuring the very low concentrations of organic substances (such as amino acid) and inorganic substances (such as ammonia). However, biological energy conversion systems have not been fully explained and enzymes are rather unstable. And so basic studies are important for engineering applications.

The research here covers: a) fundamentals on components of biological cell systems; b) electrochemical reactions of enzymes and c) measuring sensors which make use of biological cell systems.

(4) Thermally resistant enzymes and their fixation: One of the problems in industrial utilization of enzymes is the inevitability of microbic pollution because of room-temperature and normal-pressure reactions. A solution to this problem is the development of acid-resistant or alkali-resistant enzymes, and it is expected that long, continuous chemical reactions will be made possible by achieving their fixation. The research here covers: a) utilization of microbes which grow in special environments such as high temperatures and a search for heat-resistant enzymes by using such techniques as providing existing enzymes with heat-resistance, acid-resistance and alkali-resistance by treating them chemically; b) requirements for efficient production of heat-resistant enzymes, etc., c) fixation of heat-resistant enzymes, etc., and, d) requirements for the use of heat-resistant enzymes, etc.

(5) Technology for improving microbes: Important advancement of microbes can be made by conversion of their genetic properties, by variations in environment and, above all, by the application of genetic methods to medical treatment and to the chemical industry. Research here deals with technology for genetic improvement, covering: a) improvement of functions by making use of mutation; b) improvement by making use of hybridization and polyploid transmutation methods; and, c) improvement by applying the methods of genetic engineering.

(6) Pest control by making use of microbes: Studies are being promoted worldwide on insecticides harmless to humans and useful to animals and some of the results of the studies have been made practical in some countries. Research covers a) search for and production of microbes which are able to control pests; and b) simultaneous use of chemical substances, etc., to increase the effect of pest control.

Technology for Manufacturing New Materials

(1) Technology for developing extreme use materials: a) structural or adiabatic materials manufactured by making use of extreme conditions such as ultra-high temperature, ultra-high pressure and ultra-low temperature; b) structural materials with properties suited to ultra-low-temperature conditions, c) structural or adiabatic materials with excellent properties, such as high creep rupture strength, high fatigue resistance strength, high wear resistance, etc., in ultra-high temperatures, and, d) structural materials with excellent properties, such as high strength under ultra-high pressure. (The above are all inorganic or metallic materials.)

(2) Technology for developing biologically compatible materials a) materials which comprise artificial organs and which are useful in respect to functions such as permeability to gases and solvents and adsorptivity, and which are not toxic to humans, b) materials which have sufficient mechanical strength to be used as buried pieces in human bodies, have affinity with live bodies and are durable enough for long use in live bodies, c) materials highly resistant to sterilization together with technology for sterilization; and, d) the additional method of adapting artificial materials to biological tissues.

(3) Technology for developing high-molecular functional materials: a) materials which have selective permeability, adsorptivity or barrier characteristics; b) materials with high specific strength; c) materials with high thermal conductivity or high endurance, d) materials with high insulation and e) materials with high thermal resistance or excellent ultra-low temperature characteristics.

(4) Technology for developing the following materials: a) particle dispersion strength materials which make use of properties in coexisting areas; b) materials which have condensed tissue control; c) materials to be made by the most rapid liquid cooling, together with molding techniques; d) non-oxide ceramics and high-performance ceramics; and e) high-performance materials with surfaces improved by powder metallurgy or plasticity treatment.

New Electronic Device Technology

Josephson integrated circuits. Josephson elements have excellent properties, such as strikingly high speeds and low power consumption, and have been noted as computer elements effective in increasing speed and capacity. However, technology for an environment of extremely low humidity. Thus, its still involves a lot of unexploited factors, such as the necessity of an environment of extremely low humidity. Thus, its promotion is much desired to help the development of electronic devices (such as high-performance computers).

CSO: 4120/318

SCIENCE AND TECHNOLOGY

ENERGY CONSERVATION AT PLASTICS INJECTION MOLDING PLANTS NOTED

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 pp 43-45

/Text/

Energy conservation is now being advocated in many industries the world over and energy conservation policies adopted in different countries vary in accordance with local conditions. In Japan, measures to conserve resources and save energy in one way or another have been studied by all sectors of industry and some have already been put into effect.

Japanese plastic molding plants particularly, are actively studying methods to save energy necessary for their machines in response to these causes, and machines themselves are changing to the energy-saving type.

Given below is a summary of how energy conservation is now being studied in the field of plastics processing particularly regarding molding machines.

1. Energy Consumed by Injection Molding Machines

An injection molding machine is used to melt plastic raw materials by heating and to fill metal molds with the material at high pressure. Then after cooling, the molded goods are produced. To give an example of one cycle for the circuit of a pump driving motor, energy consumption during this period is greatest at the stage of injection (see Fig.1). Thus, it can be said that expedients for injection are essential to energy conservation.

2. Molding Conditions and Energy Consumption

Theoretically, the amount of energy consumed to mold the same type of item should be almost the same. But in practice, this amount varies greatly depending on the molding machine and molding conditions. From the viewpoint of energy conservation, it is necessary to pay attention to the following points:

1) Selecting a suitable molding machine.
2) Shortening the molding cycle.
3) Setting the pressure as low as possible.
4) Setting the speed as fast as possible.
5) Minimizing nozzle and mold opening/closing strokes to the greatest possible extent.

3. Energy Conservation for Injection Molding Machines

(1) Mold Clamping Mechanism

Mold clamping mechanisms can be generally divided into two types: direct pressure and toggle types. The relative superiority of the two types has been long disputed and the argument still continues.

From the aspects of energy consumption, the two types are:

1) Energy Loss in Direct Pressure Type Clamping
   a. Parts that move in opening or closing the mold are heavy, so that a large quantity oil in the hydraulic system needs to move.
   b. Energy required to extend the tie bar and compress oil in the mold clamping cylinder to a high pressure when mold closing is completed.
   c. Mold clamping force must be retained for a certain period after mold clamping is actually completed.
2) Energy Loss in Toggle Type
   a. The frictional force increases due to the great forces

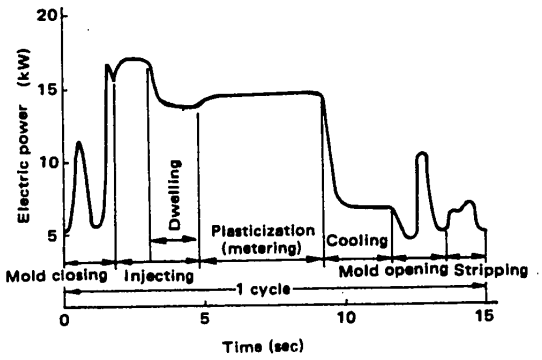


Fig. 1. Electric Power Cosnumed by Injection Molding Machine

exerted on the rotary parts of the toggle pin and the toggle link during mold opening and closing, and when mold closing is completed.

   b. Energy required to extend the tie bar and deform the toggle link by compression when mold closing is completed.
   c. The reciprocating motion of the mold opening and closing cylinder is converted into several stages of rotary motion by the toggle link and this motion finally becomes the reciprocating motion of the movable panel. Energy loss due to the transmission of motion that takes place in the meantime.

(2) Injecting Mechanisms

The in-line screw type has recently become most predominant as the most usually adopted type of injection mechanism and, for the next several years at least, no other type to replace it is likely to appear.

In the plasticizing process, some screws are driven by electric motors and others by oil hydraulic motors. The electric motor type is energy-saving in that energy in proportion to the load and not screw rotation is consumed, but it has many drawbacks, including the number of screw revolutions that must be graduated, and the necessity of a mechanism to prevent screw overtorque. On the other hand, the oil hydraulic motor type has many merits including the ability to make ungraduated changes in the number of screw revolutions.

The injecting process is equally important for energy conservation. This is being studied by the method of improving oil hydraulic circuits.

The results of comparison between venting and nonventing injectors of the direct pressure type and with a mold tightening force of 140 tons show that whereas power consumption of the vent-type injector is 0.108kWh/shot, that of the nonvent-type injector is 0.123kWh/shot, which is 13.9% larger than the power consumed by the vent-type injector.

The heating cylinder is controlled by a heater. Power consumption for this purpose is relatively small, compared with power consumption by the pump driving motor, but this control cannot be made directly. The effective use of an insulated heater cover serves the purpose of power conservation by 24–22%.

(3) Oil Hydraulic Circuits

The efficiency of oil hydraulic drives are very low (50–60%) when various efficiencies, including pump efficiency and the efficiency due to pressure losses in each piping system are taken into consideration, but oil hydraulic drives have merits that more than offset their inefficiencies, so much so that, under the present circumstances, it is difficult to replace hydraulic drives with alternative types. Consequently, the important thing is how to increase circuit efficiency of hydraulic systems. To this end, it is necessary not only to increase the efficiency of hydraulic equipment, but also to reduce pressure losses of piping systems, and to reduce energy that is wasted without being used for useful work, as well as shortening the time of consumption as much as possible. These circuits include the following:

(a) Bleed-off circuit (see Fig.2)
(b) Screw torque changeover circuit (see Fig.3)

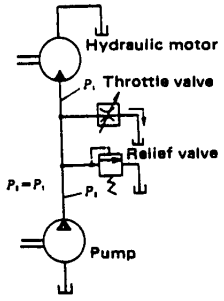


Fig. 2. Bleed-Off Circuit

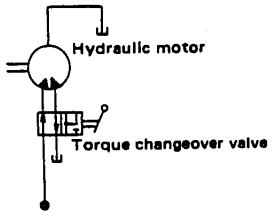


Fig. 3. Screw Torque Changeover Circuit

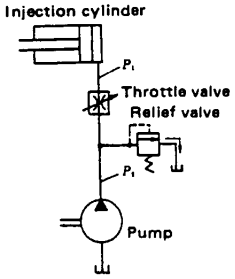


Fig. 4. Meter-In Circuit

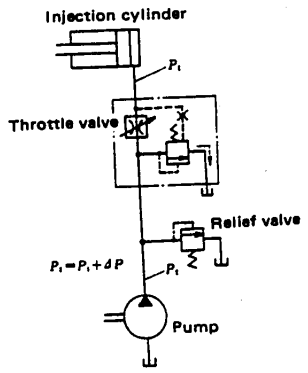


Fig. 5. Pressure Matching Circuit

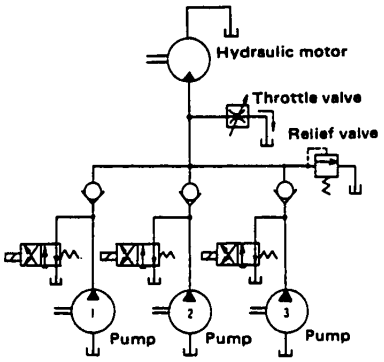


Fig. 6. Pump Selecting Circuit

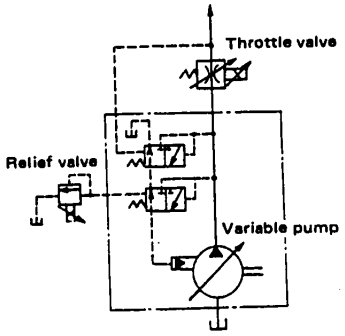


Fig. 7. Power Matching Circuit by Variable Pump

(c) Meter-In Circuit (see Fig.4)
(d) Pressure matching circuit (see Fig.5)
(e) Pump selecting circuit (see Fig.6)
(f) Power matching circuit by variable pump (see Fig.7)
(g) Accumulator circuit

(3) Others
a. Use of high-efficiency electric motors
b. Use of phase advancing condenser
c. Energy conservation by reducing scrap and by stabilized molding
d. Energy conservation by using machines exclusively for this purpose

CSO: 4120/318

SCIENCE AND TECHNOLOGY

LAVAFLAME-SYSTEM OF COKE OVEN DESCRIBED

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 45

/Text/

The life of a coke oven is long, normally 20 to 30 years, and one of the factors which determines its life is eventual damage to the carbide chamber wall brick. Conventionally, the wet-spray method has been used for repair of damaged parts of the wall brick. This method melted involves spraying ceramic suspended in water, and it rapidly cools the wall due to the use of water. This rapid cooling may accelerate the detrioration of the wall brick.Insufficient deposition requires repeated repair, which further accelerates deterioration of the wall brick, thus defeating the purpose of the repair.

For this method, the newly-developed Lavaflame-System lava-sprays a ceramic powder, in a fused condition produced by the hot flame of a gas burner, onto the damaged part. Repairs of wall joints, wall surges, and piercing stopgaps are simplified. The lava-sprayed layer that is adherent to the damaged part has such features as low porosity, high intensity, and non-separation. The new system is capable of maintaining a stonger wall for a long period of time.

This technique consists of the three elements: devices, material, and execution of work. The following are the key factors: structure of the burner; balance between material and heat; uniform stable supply; facility of material and its control function; appropriate material characteristics and method of execution of work; and measures to retain safety.

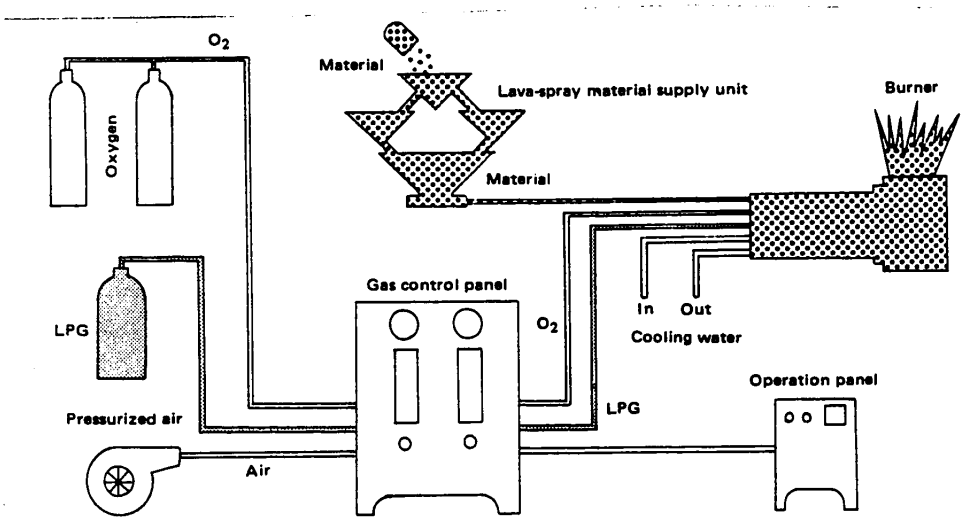


Fig. 1. Principle Diagram of the Lavaflame-System

CSO: 4120/318

SCIENCE AND TECHNOLOGY

CONTINUOUS STORAGE SYSTEM FOR INDOOR COAL STOCKING

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 47

/Text/

An indoor coaling station to be built for the Takehara thermal power plant of the Electric Power Development Co. is a large-scale dome type and has no parallel in the world, let alone in Japan. A storage/delivery system for the coal yard consists of two major facilities installed inside the dome and auxiliary systems, such as transportation from a coal landing-space to the yard. One of the two is a swivel shuttle stacker, 20m in height, with a stocking capacity of 3,000 tons/hour. The other is a 60.5m-high, total cross section cutting reclaimer with a delivery capacity of 600 tons/hour. In addition, to prevent the hazards of coal dust explosion, oxygen deficiency, spontaneous ignition and so on, all of which are possible in indoor coal storage, other devices are incorporated, such as a local dust collector, a sprinkler, a fire extinguishing unit, a ventilator/dust collector, and anti-explosion equipment. In addition, a remote, fully automatic operating system, utilizing a computer and an industrial TV to monitor the silo inside, is also part of the whole system, making it, in fact, unprecedented in the world.

The indoor coal depot is 120m in diameter, 27m in wall height, and has a dome 49m high. The depot, with a floor area of 11,400m^2, occupies 102,300m^3 and can stockpile 150,000 tons of coal. The system is to be completed in November 1982 by Mitsui Miike Machinery Co.

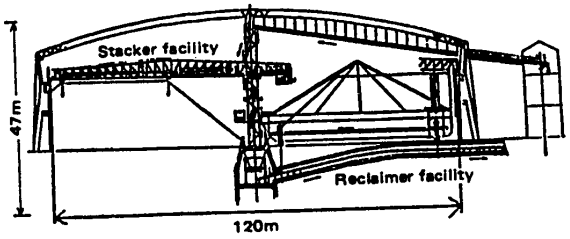


Fig. 1. Storing System of Indoor Coal Yard for Takehara Thermal Power Plant of the Electric Power Development Co.

CSO: 4120/318

SCIENCE AND TECHNOLOGY

DIRECT COAL LIQUEFACTION DESCRIBED

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 47

/Text/

Yamagata University is proceeding with experimental research of direct coal liquefaction by the M coal method and is being unexpectedly successful, thanks to the smooth operation of a continuous plug flow tube type liquefying reactor. At present, acquisition of various data is under way and the university will present the results at the "Coal Science Conference" (tentative name) to be held this autumn. This M coal process, unparalleled in the world, utilizes a continuous plug flow tube type reaction that has been developed by Professor Morita of the Faculty of Engineering. The method utilizes hydrogen continually charged into an in-process reactor, whereby a constant hydrogen concentration in the reactor is maintained for complete reaction. Consequently, the liquid produced is homogeneous. The method is drawing attention from concerned parties at home and abroad as a low-cost, highly efficient method of direct coal liquefaction. The continuous plug flow tube method, the university speculates, could become mainstream in the future.

The M coal process was named after "Morita", and was granted a patent in Japan last March. Presently, applications are being made in the U.S. for two patents: one for reaction procedure and the other for the production unit. Continuous coal liquefaction by continuous plug flow type reaction requires that a paste composed of coal less than 100 meshes, catalyst powder, and mixed oil is charged in a pressure vessel into an autoclave. Then hydrogen of 100 atm. at room temperature is introduced and heated to 400–450°C, whereby it is raised to about 200 atm. Pressurized hydrogen dissolved in mixed oil becomes active on the catalyst surface, reacts with coal powder already swelled by mixed oil after heating, entering mixed oil to form liquid.

The M coal method utilizes the disposable catalyst in slightly excessive quantities in an attempt to extract a large amount of light oil under short reaction time (about 20 minutes) at 420–450°C, and the experiment is showing positive results. Full scale tests are currently under way. With further improvement of the reactor, derived liquid of much lower cost than crude oil could be obtained, even for a chemical raw materials.

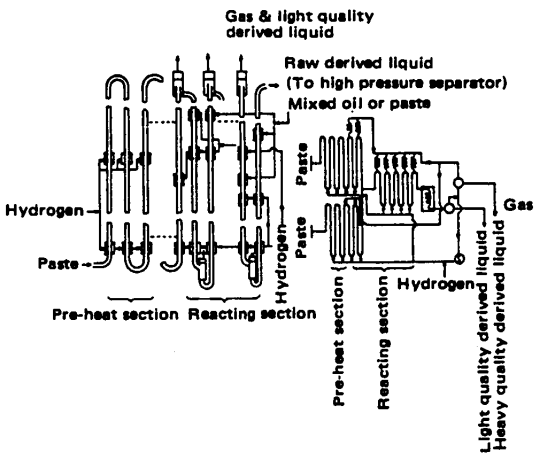


Fig. 1. M-Coal Method Flow Sheet

CSO: 4120/318

SCIENCE AND TECHNOLOGY

PLASTICS SOLIDIFICATION TECHNOLOGY FOR TREATING LOW-LEVEL RADIOACTIVE WASTE FROM NUCLEAR POWER PLANTS

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 49

/Text/

Tokyo Electric Power Co. has decided to adopt for the first time in the power industry a volume-reducing, plastics solidification process to treat low-level radioactive waste discharged from nuclear power stations. The decision was made because this method greatly excels the conventional cementing solidification in volume-reduction capability for both liquid and solid waste. The process will be first introduced into No.3 and 4 Reactors of the Fukushima 2nd nuclear power plant which are scheduled to go into operation in 1985. If everything goes well, full-dress application of the new method for treating low-level radioactive waste is intended for future plants. The power company will use the plastics solidification method in the process of packing nuclear waste in drums.

The plastics solidification method has been put to practical use as a result of development efforts jointly made by Tokyo Electric and other power companies with reactor related makers such as Hitachi, Ltd. and Tokyo Shibaura Electric Co. Tokyo Electric Power Co. and Chubu Electric Power Co., which had adopted the BWR method, have hitherto used cement while Kansai Electric Power Co. and other companies, which adopted the BWR method, are using asphalt to treat radioactive waste.

The plastics solidification process is capable of reducing liquid and solid waste volume to 1/6 and 1/4, respectively, compared with the cement process.

When the plastics solidification method is introduced into the Fukushima 2nd plant, the amount of radioactive waste from one reactor will be curtailed to 600 200 litre drums (in terms of drum volume) annually, or only one-fifth of 2,800 drums accruing from the cement method. A plastics solidification plant will be built within the low-level radioactive waste treatment facility to be established at the Fukushima No.3 and 4 reactors. The plant will consist of dryers, a powder hopper, a mixer and other equipment. Radioactive waste will be dried and then pulverized following which it will packed in drums together with a plastic hardener.

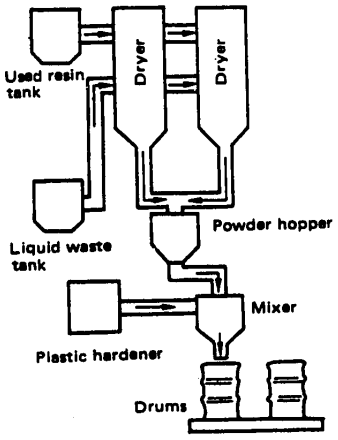


Fig. 1. Schematic Diagram of Plastics Solidification System

CSO: 4120/318

SCIENCE AND TECHNOLOGY

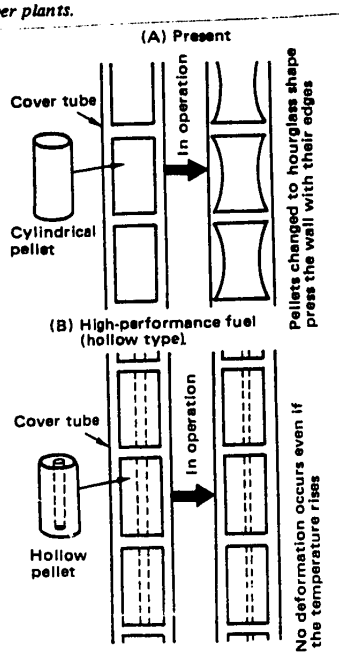
HIGH-PERFORMANCE REACTOR FUEL FOR CONTROLLING OUTPUT OF NUCLEAR POWER PLANTS

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 49

/Text/

The Nuclear Power Engineering Test Center, a foundation, is aiming to develop a high-performance reactor fuel, which can reduce the output of nuclear power plants by half during the night, under a 7-year plan. At present nuclear power stations are operating with constant output day and night so that fuel rods will not be damaged by thermal fluctuations. Constant output is all right if the share of nuclear energy in the total supply of electric power is 12% as at present, but if the ratio is to be increased to 20–30%, it will be necessary to respond to changing output in day and night. The center has been entrusted by the Ministry of International Trade and Industry (MITI) with developing a high-performance fuel which can respond to such a load change. If a high-performance fuel is developed, it is expected that the operation of nuclear power plants can be made flexible.

The temperature of fuel pellets rises to 1,000–2,000°C when a reactor is running so that their simple cylindrical shape changes to an hourglass shape. There is no problem of a nuclear power plant is operating with a constant output as at present, but in case the output is changed every day and night, the temperature of fuel pellets changes to cause repeated deformation. As a result, it is feared that the force pushing an alloy cover tube might damage the fuel rods. Consequently, the center aims to develop a fuel assembly housing improved pellets which are hollow or are shaped like a barrel so that no force is exerted to the cover tube even if the temperature changes. Even if barrel-shaped pellets, packed in a cover tube, change to an hourglass shape and will remain cylindrical in shape. As it is the edges of hour glassshaped pellets which press the cover tube due to thermal distortion, there is no fear of damaging the tube if the pellets remain cylindrical in shaped. On the other hand, hollow pellets will not change from a cylindrical type to an hourglass type, and no force is exerted to the tube. Which of the two methods is better will be confirmed by tests. Inert helium gas is put in the cover tube which is then sealed, but in the case of a high-performance fuel, pressurized helium is put in the tube to raise the density in the sealed tube. This will improve thermal conductivity and curb the rise in the temperature of the pellets. By combining with improved type pellets, the center intends to further curtail deformation of pellets by heat so that the output of nuclear power plants can be changed as in the case of thermoelectric power plants.



CSO: 4120/318

SCIENCE AND TECHNOLOGY

IRON, STEEL PRODUCTION IN FY 1980

Tokyo TECHNOCRAT.in English Vol 14, No 6 Jun 81 p 51

/Text/

The following data on iron and steel production in FY1980 are based on a report by the Japan Iron and Steel Federation.

The production of pig iron, crude steel, and ordinary hot rolled steel decreased 0.1%, 5%, and 6.1%, respectively, from the previous fiscal year's level. However, the production of special hot rolled steel rose 4.2%.

Pig iron production totaled 85.09 million tons, showing a small drop of 0.1% or 120,000 tons from the previous year. It amounted to 93.2% of the record production of 91.26 million tons set in 1973. Of pig iron production, blast furnace pig iron registered 84.84 million tons, down 0.2%, or 200,000 tons, from FY 1979.

Of the 65 blast furnaces available (except for those idle), the number of furnaces in operation as of the end of FY1980 was 44 while the previous year recorded 43.

Crude steel production declined 5.0% or 5.62 million tons from the preceding year to reach 170.39 million tons, which was 10.5% or 12.63 million tons lower than the record production of 120.02 million tons registered in 1973.

By type, production of ordinary steel totaled 90.30 million tons, down 6.6%, or 6.35 million tons, from the level the year before, while special steel increased 4.4%, or 730,000 tons, to 17.09 million tons, registering a record high for five consecutive years.

By furnace type, Bessemer steel production dropped 5.2%, or 4.47 million tons, to 81.22 million tons. Electric furnace steel amounted to 26.16 million tons, down 4.2%, or 1.16 million tons, from the preceding year's level.

The ratio of continuous casting of steel to total ingot production for rolling has been rising year by year. It marked 63.2% in FY 1980, up 8.2 points over the previous year's 55.0%, registering above the 60% level for the first time, on a yearly basis, while it marked 69.6% in March, 1981, coming up to the 70% level on a monthly basis.

The production of ordinary hot rolled steel materials fell 6.1%, or 5.43 million tons, to reach 83.86 million tons. By type, strip steel production was 28.11 million tons, down 8.4% (2.59 million tons) from the year before; 12.37 million tons, down 14.7% for bars; 11.34 million tons, down 15.3% for small bars; 10.17 million tons, down 1.9% for sections; 5.09 million tons, down 3.9% for wire rods, and 490,000 tons, down 9.8% steel rails. On the other hand, the production of steel plate marked 52.97 million tons, down 5.5% or 310,000 tons; 11.99 million tons, up 4.2% for thick plate; 36.81 million tons, down 7.4% for wide band palte; 1.57 million tons, down 12.6% for band steel, and 590,000 tons, down 27% for thin plate.

The production of ordinary hot rolled steel and wide band steel also feel to 20.28 million tons, down 5.8% or 1.24 million tons. However, seamless steel pipe production marked a record high of 1.95 million tons, up 3.0% over the year before.

The production of special hot rolled steel

materials increased 25.3%, or 560,000 tons, to 27.5 million tons, while that of stainless steel dropped 8.0%, or 150,000 tons, to 1.72 million tons.

The combined production of ordinary and special hot rolled steel materials registered 96.96 million tons, down 4.8% or 4.90 million tons. The figure represents 96% of the record production of 101.21 million tons set in 1973.

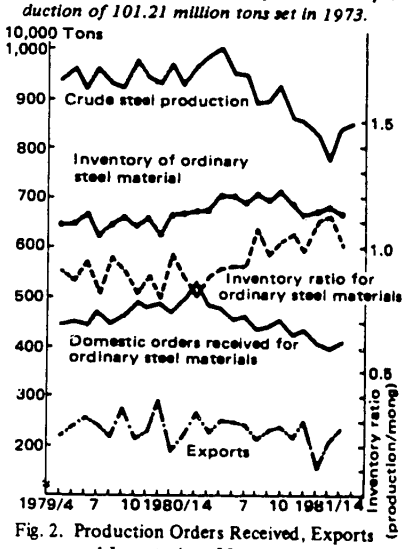


Fig. 2. Production Orders Received, Exports and Inventories of Iron and Steel

CSO: 4120/318

SCIENCE AND TECHNOLOGY

CONSTANT PRESSURE GRINDING DEVICE FOR CURVED SURFACE

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 57

/Text/

Processing of a three-dimensional curved surface, for instance, that of a dye cavity, has been gradually mechanized by introduction of NC machines. Its finishing process, however, is not yet mechanized. The reason why a three-dimensional curve is not processed by machine is that it is difficult to control the pressure direction of tools adapted to the shape of other works.

The Mechanical Engineering Laboratory has engineered a prototype constant pressure grinding device which controls the pressure direction of a tool utilizing an NC tape. The NC tape was used as a control tape for processing work at the NC machine or MC. The device proved to be very useful. As shown in Fig.1, the angle of elevation α and azimum angle β of the normal line, in at the point p are described as follows:

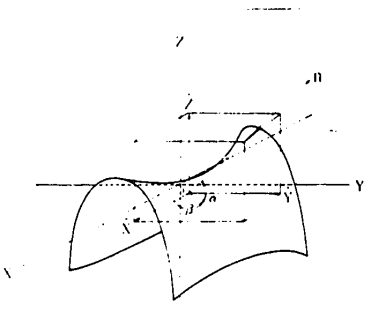


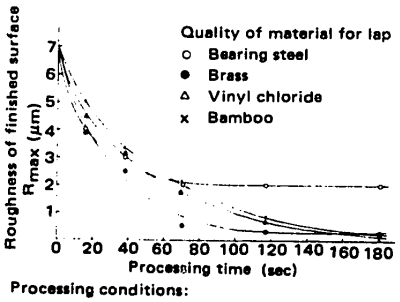
Fig. 1. Concept of Pressure Direction Control

Where X, Y and Z are the elements of the feed speed of the tool.

Therefore if we can determine X, Y and Z, we can control tools.

Fig.2 shows the device engineered for the NC milling machine or machining center.

Fig.3 shows the results of processing by this device. If adequate lapping materkal is used, a good R_{max} 0.1μ surface is obtained.



Processing conditions:
Surface roughness prior to processing – 7μm
Work – S55C
Size of grindstone material – diamond paste 6μm
Working pressure – 200g
Feed speed – 0.2m/min
Tool configuration – φ8 (hemisphere)
Oscillating amplitude of tool – 10mm
Oscillation frequency – 7Hz
Processing time is per cm^2 of processed surface

Fig. 3. Surface Roughness

$$\alpha = \tan^{-1}\left(\frac{Z}{\sqrt{X^2 + Y^2}}\right)$$

$$\beta = \tan^{-1}\left(\frac{Y}{X}\right)$$

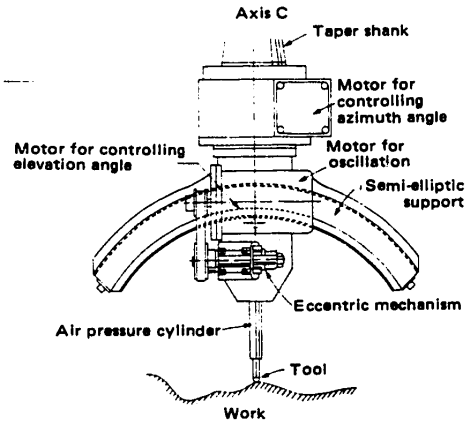


Fig. 2. Structure of Constant Pressure Grinding Device

CSO: 4120/318

SCIENCE AND TECHNOLOGY

NEW TECHNOLOGY FOR SEPARATING PARTICULATES FROM AIR FLOW

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 59

/Text/

Osaka Prefectural Industrial Research Institute, in cooperation with City University of England, has developed new technology for separating airborne solid particulates from an air flow. The Institute says there is prospect of putting the technology to practical use.

According to the Institute, if an air flow containing solid particles and running at a high speed is turned sharply, these solid particles persist in running straight because of their large inertia. The new technology makes use of this phenomenon and collects solid particles deviating from the air flow. In order to turn the direction of the air flow, the new technology applied the principles of pure-fluid elements called the Coanda effect instead of conventional methods. If an inclined wall is located near a nozzle which jets out a fluid, the fluid changes its direction in such a manner as to parallel the wall surfaces. The Coanda effect indicates this phenomenon.

The results of separation and collection tests using a model system (see Fig.1) manufactured by the Institute have proved the following:

(1) Crispy particles more than 25 microns in diameter can be caught almost 100% irrespective of their shape.

(2) Particles such as powdered milk or flour which readily gather to form cloudy masses cannot be separated.

(3) The new technology can be applied in classifying particles in accordance with their weight and size, in addition to separation of solid particles from an air flow.

With the recognition that principles for practical use have been proved, the Institute intends to study the method of practical application to powder industries such as the transportation of pulverized coal.

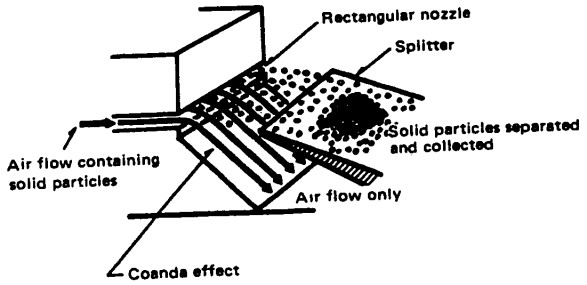


Fig. 1. New Technology for Separating Particulates from Air Flow

CSO: 4120/318

SCIENCE AND TECHNOLOGY

NEW POSITIVE PHOTORESIST

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 61

/Text/

The Government Laboratory of Chemical Technology of the Bureau of Industrial Engineering has developed a new, highly sensitive positive photoresist for the purpose of electron beam exposure.

This new photoresist is a polymeric material having a molecular wieght of the order of 10^4 to 10^5. The polymer has a sulfide bond in which two carbon atoms and one sulfur atom are bonded. By the radiation of an electron beam, the sulfide bond is split, and the polymer becomes soluble. Thus a positive pattern is obtained. Its sensitivity is ten times higher than polymethylmethacrylate(PMMA). The new photoresist is prepared by ring-opening polymerization of the ring sulfide compound as the raw material. Various kinds of ring sulfide compounds can be used as raw materials, and the ring-opening polymerization takes place in an organic solvent, catalyzed by zinc or cadmium oxide and sulfide. The reaction is easily done below 100°C. Thus, sulfide polymers such as polypropylene-sulfide, poly(1,1-methyl-ethyl-ethylene- sulfide), and poly(1,1-dimethyl-ethylene sulfide), have been obtained, and all these show the function of a positive photoresist.

Among these, the properties of poly(1,1-methyl-ethyl ethylene sulfide) are now compared with those of PMMA by the Toray Research Center. In the case of the film thickness of 0.7mm irradiated by the electron beam with an accelerating voltage of 30kV, the radiation charge of 1×10^{-5} Coulomb/cm^2 was enough to dissolve completely the irradiated part in a solvent. Thus, the high sensitivity of this resist has been confirmed to be ten times higher than PMMA.

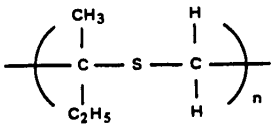


Fig. 1. Molecular Structure Formula of Poly Poly(1,1-methyl-ethyl Ethylene Sulfide)

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SCIENCE AND TECHNOLOGY

NEW MEDIA FOR VERTICAL MAGNETIC RECORDING

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 61

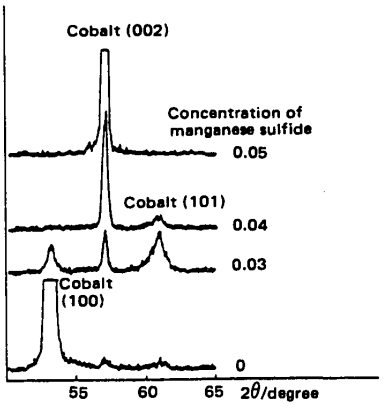
/Text/

The vertical magnetic recording system attracted attention as an innovative technique which increases remarkably the recording density of magnetic recording equipment such as the magnetic disk. Waseda University and NEC have discovered the possibility of preparing vertical magnetic recording media by a non-electrolytic electroplating method. They have prepared high quality film vertically oriented along the c axis, by mixing a small amount of manganese in the non-electrolytic cobalt phosphor electroplating film.

The method of forming magnetic film by the non-electrolytic electroplating method is considered to be cheaper than the sputtering method, but until now c-axis orientation of the hexagonal crystal system is said to be difficult to achieve direct perpendicularity with the film surface. For the hexagonal crystal to become vertical, vertical anisotropic energy is necessary, and it must be larger than the force directing away from the vertical direction, namely the demagnetizing field. Therefore, magnetic saturation must be small in errer to have any possibility of suppressing the demagnetizing field.

Accounting for the above situation, it was found that, in the non-electrolytic plating film of cobalt-manganese-phosphor, the c-axis orientation of alpha-cobalt (hexagonal habit) crystal can be easily changed from the direction along the film surface to perpendicular to the surface by increasing the concentration of the added manganese to reduce the saturation magnetization in the preparation bath.

The experiment has shown that the saturation magnetization decreases remarkably when the concentration of manganese sulfide exceeds 0.04 mole/liter, while the magnetic anisotropic energy was, about -1.5×10^{-6} dyne.cm(erg) per c.c.. Though the energy shows minus value, it may be possible to satisfy the conditions necessary for vertical magnetic recording by decreasing the demagnetizing field further in near future.



(100) means the direction of the hexagonal crystal along the film surface
(002) means vertical direction of the crystal to the film surface

Fig. 1. X-ray Diffraction Patterns

CSO: 4120/318

SCIENCE AND TECHNOLOGY

WET TYPE ALUMINUM ETCHING APPARATUS

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 61

/Text/

Sigma Technical Industry has developed a wet type aluminum etching apparatus for semiconductors. This apparatus is a new system, including the automatic and point detector of aluminum wiring, developed by the company last November. Using this apparatus, the judging of the end point of etching, that was heretofore done visually has been automated, and exact etching has become possible. Accordingly, it is hoped that the quality of products will be greatly improved.

This apparatus can treat 25 wafers in a batch. When the carrier loaded with wafers is set, and the start button is pushed, the carrier is dipped into the etching bath, and etching starts. After the automatic end point detector detects automatically the end point of etching, the carrier is lifted out of the etching bath, and moves to the washing bath where it is washed with water.

The main features are as follows:

(1) Optimum etching is possible, independent of any variation in personal technical ability.

(2) Automatic operation and saving of man power.

(3) Small size apparatus; improvement in reliability

(4) Using a microcomputer, automatic detection of the end point is possible, corresponding to the changing etching rates dependent on the etching solution. Thus the same solution can be used several times.

Wafer size:	*2,3,4,5 inches*
Number of wafers treated:	*25 wafers/batch*
Treating rate:	*150 wafers/hour*
Etching temperature:	*45 to 70°C*
Thickness of aluminum film:	*0.5 to 5μm*
Rate of washing water:	*1.5kg/cm², 20 l/min*
Dimensions:	*Width 1200mm x height 1150mm x depth 800mm*
Power supply:	*AC 100V, 1kVA*

The price is about 1,300,000 yen.

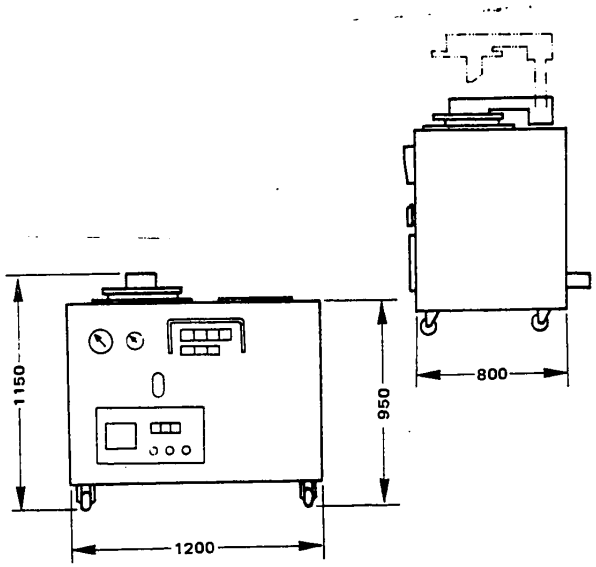


Fig. 1. Wet Type Aluminum Etching Apparatus

CSO: 4120/318

SCIENCE AND TECHNOLOGY

NEW PLASTIC CONNECTOR FOR OPTICAL FIBERS

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 63

/Text/

Various types of optical connectors have been developed so far, but because such connectors are almost always manufactured using precision machining technology, their cost has been very high. For practical use, however, connectors must be cheap and easy to assemble under all field conditions, and to achieve these objects molded plastic is the best solution. Furthermore, in order to produce a connector for field use and using plastic molding methods, the forming of microscopic cavities having accurate dimensions and precise molding technology had to be developed.

Under these circumstances, the Electrical Communication Laboratories of Nippon Telegraph and Telephone Public Corporation have developed new forming technology for cavities in which an electroforming process forms a complicated and microscopic structure of cavities with very high accuracy. A rod with a pinhole made by precision machining is used. The pinhole, with a 126μm diameter, is positioned at the center of the tip with an eccentricity of less than 2μm. The rod is first immersed in an electroplating bath until a layer is deposited on the rod master (Process A). When the master obtains a layer thick enough to be used as a mold, it is then removed from the mold. This process permits very precise manufacturing of a mold for the plastic connector's plug ferrules.

The removed rod master can be reused by replacing a core pin, for repeating the electroforming process. Thus, several molds with the same accurate size can be manufactured. Phenolic resin containing short glass fibers is employed as the molding material which provides both the mechanical strength and dimensional stability sufficient for plug ferrules. The average connection loss is 0.53dB.

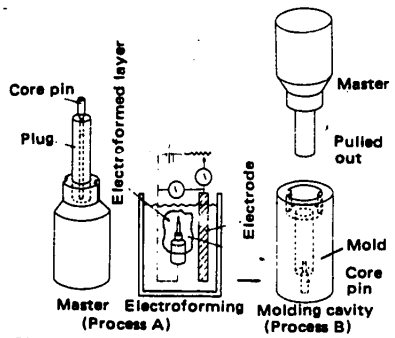


Fig. 1. Manufacturing Process for New Optical Fiber Connector

CSO: 4120/318

SCIENCE AND TECHNOLOGY

FIELD TEST OF MOBILE TELEPHONE SERVICE SYSTEM FOR SMALL, MEDIUM-SIZED CITIES

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 63

/Text/

After developing a mobile telephone service system for small- and medium-sized cities, the Electrical Communication Laboratories of Nippon Telephone and Telegraph Public Corporation, have been engaged in field tests of a system to expand the system nationwide. It is reported that the tests have been completed with favorable results.

In major local cities, and small- and medium-sized cities in their environs, the number of potential subscribers for mobile telephone services ranges from 5,000 to 20,000. There are relatively few densely populated areas having high-rise buildings, but as they do have complicated geographical features, being surrounded by the sea and mountains, long and slender service areas are common. The success in the field tests has established a technical base to expand the mobile telephone services to local areas under the above-mentioned conditions at a per subscriber cost as much as that for large cities such as Tokyo.

The new system has been completed using the following new technologies: (1) The development of a radio circuit control system and a mobile telephone exchange system both being optimum for limited area use. (2) Improvement and miniaturization of radio transmission/reception devices and antenna systems. (3) The development of a small substation for use in blind areas.

Table 1. Main Specifications of Mobile Telephone Service System for Small- and Medium-sized Cities

	New system	Conventional system
Subscription capacity/ radio circuit control unit	Standard 5,000 (max. 20,000)	Max. 50,000
Number of radio zones/ radio circuit control unit	Standard 8 (max. 32)	Max. 32
Number of call channels/ radio zone	Standard 12 (max. 32)	Max. 128
Radio zone construction	Circle and fan shaped zones. Radius: 10-20km	Basically circle shaped zone. Radius: 5-10km

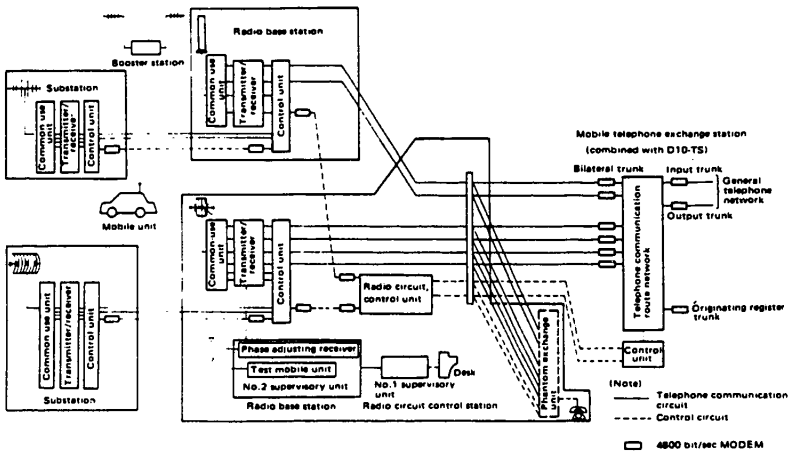


Fig. 1. Field Test Circuit Configuration for Mobile Telephone Service System for Small- and Medium-sized Cities

CSO: 4120/318

SCIENCE AND TECHNOLOGY

INTRODUCTION OF OA GAINS MOMENTUM

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 64

/Text/

* Japanese industrial circles are actively introducing the office automation (OA) system. The system is designed to help offices survive the composition between Japanese enterprises in the strict business environment of the 1980's. This is being done by in depth rationalization of management administration departments which lag behind work at the plants.

For example, Kawasaki Heavy Industries, Ltd. has been operating a system of preparing, editing and looking up documents at its Kobe plant since the 1981 business term. Under this system, specifications and estimates are drawn up in foreign languages – English, German, French and Spanish – and documents, which have been put in once, can be instantly revised and re-edited. The work of preparing documents can thus be greatly reduced (it can save 60 million yen a year).

In order to vigorously push OA forward, Nippon Electric Co., Ltd. plans to invest about three billion yen to establish a nation-wide network of data communication lines for its exclusive use under a 5-year program. It is aimed at a uniform operation of the OA communication system by linking computers as well as terminals, facsimiles and TV meeting systems with the lines.

According to a survey of major enterprises made by Nihon Keizai Shimbun, enterprises which have set up committee intending to introducing OA, account for 5.5%, and enterprises which are studying the possibility of introducing OA account for 26.67%. Of some of the enterprises listed on the stock exchange, 77.2% recognize the importance of OA and are showing a forward-looking posture on this matter.

More than 50% of the listed enterprises predicted that both the adoption of the Japanese language word processor and the corporate-wide standardization and unification of documents and vouchers would be made five years hence.

(1) In what way is OA discussed in your company (composition ratio of replies to questionnaire recurred from head offices of 741 enterprises). (2) Staff in charge of enterprises have never heard the word OA. (3) Others (4) A special department has been set up to tackle OA. (5) A related department is studying OA. (6) Not studying OA at present. (7) One thousand leading companies, mainly enterprises which are listed on the stock exchange and which have head offices in Tokyo-to, Osaka-fu and Aichi Prefecture, were polled as of the end of February 1981.

CSO: 4120/318

SCIENCE AND TECHNOLOGY

MULTIDISPLAY SYSTEM (MDPS) DESCRIBED

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 65

/Text/

Densoken has developed a multidisplay system (MDPS) as a good example of improved software support. MDPS is a system that has been developed from the idea of a tool incorporating hardware, that is moderately priced and easy to operate; the idea is one step ahead of regarding tools only in terms of software.

The time-sharing system has been widely used in the past. Terminal units have not been confined merely to input and output devices, and devices called intelligent terminals, which are provided with processing ability, have come into existence. Judging from this point of view, the MDPS can be said to be one of them. However, it does not mean that the terminal device has been provided with just calculation functions. It has distinctive features which appear to users as being totally different from conventional terminals. MDPS is aimed at easing the burdens of users through the process of developing software by making increases in the number of the display units.

What should be done when making software programs. Before writing a program, that is, coding, a method of solving problems (called an algorithm) should be conceived or a decision should be made by referring to materials or books. Next, a design has to be worked out on how to execute the method with a computer. Usually one divides the method into modules, decides on the interface between each module, and also determines the architecture of the computer or the structure of data as how to express them in programming language. Such decisions are usually made by using many sheets of paper, at the same time writing about different things while referring to materials. It is said that the more time is given to working this design, the easier at will be later.

After completing the design of the program, coding is executed, and while mistakes in typing are corrected, the program is input into the computer in anticipation that the program will run as desired. Usually, since a program does not run simply, the program invariably undergoes a process called debugging. After many hours spent in correcting mistakes in thinking, typing, etc., the program reaches its final stage.

MDPS is to support this development process. One sheet of paper is replaced by one screen and the method of writing by the keyboard or a light pen. Another screen can be used as one would use another sheet of paper. Or another blank screen can be used after saving the previous data on the same screen just as one turns over the pages of a notebook. Real power is displayed when a comparative study of the contents of data written on many sheets of paper has been made. Up to 4 screens (3 in the case of a photograph) can be used to compare them. After the pages have been turned over, their management will be done by a software routine, which becomes the file system.

For reference material, at the time of deciding the algorithm, the file system is helpful. Of course, existing data of a large-sized computer as of the host side, may be used as they are. Also the group of software tools, which has been used in the usual meaning, is provided in an easy-to-use form and is managed physically as the software system. It is also provided with superposing functions to process several screens at one time including figures and characters.

Usually an editor, mainly with modification functions is used at the time of input work on the program. This holds true also with MDPS. However, thought is given to

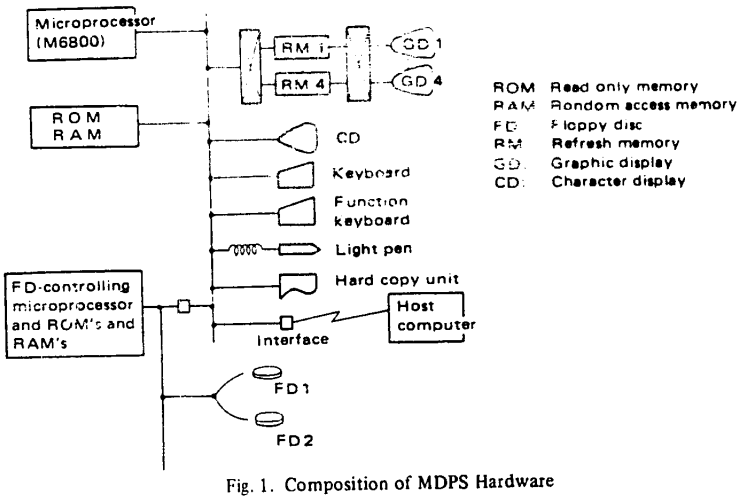


Fig. 1. Composition of MDPS Hardware

verifying the multiple screens by looking at them before and after they are changed or to making program editing easy by not losing sight of the trees while looking at the forest. Concerning debugging, the data of values at the desired places may be put on different screens if a primitive debugging method (pursuing assiduously the contents of the memory or the register at some point of time or the values of variables) is taken. This will eliminate the trouble of taking hard copies and will save resources, that is, paper.

The hardware composition and software composition of MDPS are as shown in Fig.1 and 2, respectively.

- MDPS software
  - Basic software
    - MDPS monitor
    - File system
  - Programming tool
    - General-purpose programming tool
      - MDPS editor
      - File access program
      - File transfer program
    - MDPS program creating tool
      - μPL language
      - FD file management library
      - Text and page management library

Fig. 2. MDPS Software Components

CSO: 4120/318

SCIENCE AND TECHNOLOGY

HIGH-PERFORMANCE ELECTRON MICROSCOPE

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 67

/Text/

Japan Electron Optics Laboratory Co., Ltd. has begun marketing the "JEM-1200EX", a high-performance electron microscope, starting April 1, 1981.

The JEM-1200EX is a device to meet the needs for an electron microscope at the level of atoms and molecules in the areas of materials science and gene engineering in medical science. It uses a sputter-ion pump and axial-flow molecular pump so that information cannot be lost or distorted, and realizes a clean, high vacuum under the dry vacuum system.

The electronic optics system uses a 6-step imaging lens of the 3-group configuration – the first of its kind in the world – and enables a wide range of magnifications (X50 to X100 million). In addition, the IAAA system simplifies the operation of axis setting. The operation guidance is displaced on the CRT at each step of axis setting, simultaneously automatically set to the optimum condition.

The electron microscope is priced at ¥42 million.

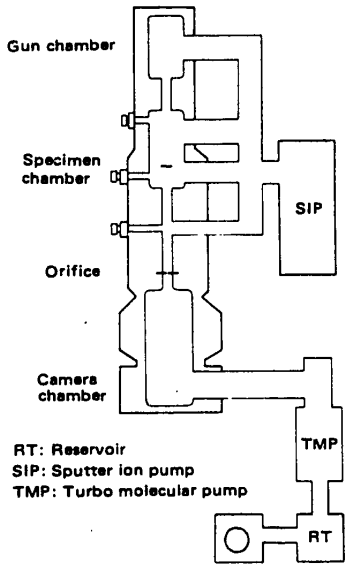


Fig. 1. Schematic Diagram of Evacuation System

CSO: 4120/318

SCIENCE AND TECHNOLOGY

GROWING A LARGE-SIZED SINGLE CRYSTAL OF MOLYBDENUM DIOXIDE

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 68

/Text/

* The Government Industrial Research Institute, Nagoya, has succeeded in growing a large-sized single crystal of molybdenum dioxide. This has been attained by using alkali borate as a flux.

While there are many kinds of molybdenum oxide, molybdenum dioxide has the most useful properties. Molybdenum dioxide in itself is a compound with high metallic-electric-conductivity. However, attention is focused on molybdenum dioxide as a solid electrolyte and as a material for an electrode because addition of a small amount of lithium or sodium gives it the function of an ion conductor.

Single crystals of molybdenum dioxide had previously been grown, mainly, by chemical transport in a sealed tube, and had rarely been grown by the flux method.

It is said to be difficult to control the atmosphere in the crystal growth process with the flux method. The Institute has obtained a large-size single crystal 6mm long with a width of 1mm by using a growth furnace capable of controlling the atmosphere.

In the growth process of single crystals it is necessary to control the partial pressure of oxygen in the atmosphere so that molybdenum dioxide may exist stably without decomposing. The Institute is using nitrogen gas containing about 10^{-8}mm Hg oxygen.

The method of growing single crystals is as follows: Alakli borate is taken as flux, Molybdenum dioxide powder as material, 20–30% of the flux, is added. The mixture is maintained in a platinum crucible at 1,250°C for twenty hours, then cooled slowly at the rate of 5°C per hour.

The single crystal grown is in the form of a quadrangular column and has a brown-purple metallic luster.

CSO: 4120/318

SCIENCE AND TECHNOLOGY

PRACTICAL USE OF ASYMMETRIC SYNTHESIS CATALYST

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 68

/Text/

* Tokyo University has developed a technology to produce optically active compounds, such as hormones and antibiotic agents, with a high yield. The Research Development Corporation of Japan is trying to put the technology to practical use.

Optically active compounds, such as hormones, antibiotic agents and pheromones, which exist in natural organic compounds in small amounts, are used in medicines, agricultural chemicals and perfumes, and they are gaining in importance. Two methods to isolate the optically active compound and the isomer from racemic compounds synthesized, and a derivative conversion method from the active compound itself have been developed. However, mass production is difficult as there are problems associated with these methods, such as complicated processes, low yield (50%) and difficulty in getting optically active compounds as raw materials. Thus, asymmetric synthesis is being watched with keen interest as a promising method for increasing not only the yield but production.

The present yield level by the asymmetric synthesis method is about 85%, but theoretically, a 98% level is obtainable and much research is being made. Turning its attention to the newly developed technology in research of its own, the Research Development Corporation of Japan has studied the possibility of putting the technology to practical use. It was found that, by using the new technology, optically active diamines or diaminoalcohols (synthesized from s-proline) act as excellent asymmetric ligands for lithium aluminium hydride and organic metal reagents. Optically active secondary alcohol can be obtained with a high asymmetric yield above 90%. Further, imidazolycine or l-ephedrine, derivatives of the optically active diamines, can be used for synthesis of optically active oxazepine derivatives. By utilizing the strong interaction between the optically active hetrocyclic compounds and various organic metal reagents, the intermediates of alcohols, aldehydes and carboxylic acids can be produced in a high yield. Physiologically active compounds, such as indolmycin which has antibacterial activity with staphylococcus maringoride (which kills cold and tuberculosis bacteria), flotaline as an insect pheromone, and s-3-butyl-phthalide found in celery have been synthesized by using these intermediates. The asymmetric yield exceeds 95%, which is very high even among conventional methods.

The Research Development Corporation has plans to entrust technical specifications to make a commercial system and to put their discovery to practical use by a company selected from an official invitation.

CSO: 4120/318

SCIENCE AND TECHNOLOGY

DEVELOPMENT OF NEW ACTIVE CARBON

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 68

/Text/

* The Nagoya Municipal Industrial Research Institute has developed active carbon of a new type which efficiently adsorbs heavy metal ions.

The adsorption capacity of active carbon is high for organic substances but low for heavy ions. For example, a gram of active carbon can adsorb as much as 400ml of benzene, but only 2–3mg of heavy metal ions.

The newly developed active carbon has an adsorption capacity almost equal to that of chelate resin, the typical heavy metal adsorbent, and it is confirmed that new active carbon can adsorb more than 10% of hexavalent chromium ions.

While the production cost of chelate resin is high, this active carbon is produced at a fraction of the cost. Moreover, it can remove both organic substances and heavy metal at the same time. Because of these advantages the new active carbon is attracting attention.
attracting attention.

Active carbon is generally produced as follows: Wood flour, charcoal from coconut-shell, and coal are heated at 1,000°C, and steaming them yields the carbon. New active carbon is attained by baking at low temperature, 500–600°C, with phosphoric acid used instead of steam.

This active carbon has acidic functional groups on the porous wall, and the size of a pore is larger than that of active carbon on the market. It has been confirmed that the quantities of adsorbates, copper and iron ions, are about 1.5% of the weight of the adsorbent, active carbon.

CSO: 4120/318

SCIENCE AND TECHNOLOGY

NEW METHOD FOR MANUFACTURING SINTERED CERAMICS OF NITRIDE

Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 69

/Text/

Osaka University and the National Institute for Research in Inorganic Materials of the Science and Technology Agency have separately developed a new method for manufacturing sintered silicon nitride.

As ceramics of silicon nitride system are superior to metals in terms of heat resistance and mechanical strength, study and development aiming at a high-temperature structural material for a gas turbine engine and the heat exchanger of a gasifier furnace are conducted all over the world. The atmospheric sintering and hot press methods are common in general sintering technologies for ceramics of nitride. However, the addition of an activator such as magnesium oxide or yttrium oxide is necessary in both methods, as the compounds of silicon nitride system have sintering resistance and, as a side effect, it reduces the strength. Therefore, the development of a new manufacturing technology not requiring the use of any activator is desired.

Osaka University has established a technology, called the "solid compressed method", involving operation at high temperature and high pressure, such as 1,400–1,900°C and 100,000 atm. The sintered ceramics of nitride thus produced had high hardness and excellent heat resistance. The method is as follows:

Silicon is sintered at 1,300°C in nitrogen atmosphere and the resulting silicon nitride power is pelletted and sintered by the solid compressed method. The sintered material has direct interparticle bond and, excellent heat resistance. Even at a temperature exceeding 1,000°C, there is no rapid decrease in hardness as seen in the case of materials obtained by an addition of activator. The method is considered highly promising for the production of ceramics of nitride.

Ford Motor Co. of the United States is pursuing research and development of a technology to produce sintered ceramics of nitride without using an activator, but to date, the product is porous and the strength is inadequate.

The method developed by the National Institute for Researches in Inorganic Materials a high pressure gas reaction sintering method. Yttrium oxide and aluminium nitride are used in the ratio of 1 to 9. The sintered material can be obtained by heating the raw material at 1,950–2,300°C under 50–500 atm nitrogen gas, and the bending strength is 30–40kg/cm² at 1,300°C, that is, approximately double that of conventional atmospheric sintered materials.

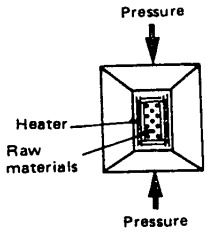


Fig. 1. Conceptional Diagram of Solid Compressed Method Developed by Osaka University

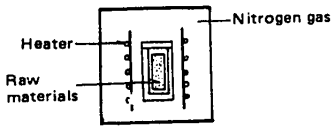
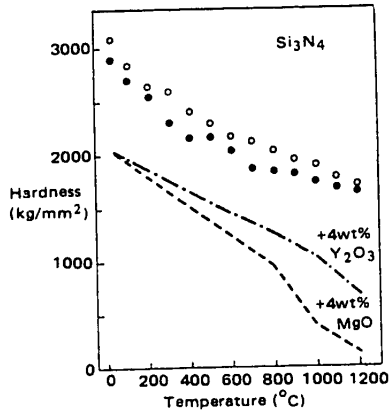


Fig. 2. High Pressure Gas Reaction Sintering Method Developed by the National Institute for Researches in Inorganic Materials



(Perforated lines indicate that an activator was added for sintering)

Fig. 3. Hardness, at High Temperatures, of Sintered Ceramics of Nitride

CSO: 4120/318

SCIENCE AND TECHNOLOGY

USE OF NEW MATERIALS IN AUTOMOBILE PARTS EXAMINED

Tokyo NIHON KOGYO SHIMBUN in Japanese 22, 23, 24 Jun 81

[Article by Shunsuke Takahashi, Staff reporter]

[22 Jun 81 p 7]

[Text] The automobile parts industry has been developing new materials at a rapid pace. This is because while the automobile manufactuers are expanding their sales in the world markets, they are demanding that the parts industry strengthen its technological development in terms of quality. The automobile manufacturers are hurriedly reinforcing the quality of automobiles as a countermeasure to future small car competition with the big three in the United States as well as for intensified domestic sales. For this reason, in ordering parts, the manufacturers have adopted a "selective" purchase attitude which is not swayed by previous commitments based on affiliation. Based on this, the parts industry is also trying to consolidate its development system in order to survive the competition which is expected to intensify in the future and at the same time it is eyeing the adoption of parts found not only in the domestic market but also in overseas markets, so as to strengthen its international competitive power in terms of technology. The concrete goals of the development of new materials vary, but the main ones are the reduction of automobile weight for fuel economy, which is first on the list, the improvement of durability, and safety and pollution measures; the number of cases in which these goals are combined is increasing. In any event, those parts manufacturers which cannot respond to the demands of the automobile manufacturers will be left out. For this reason, behind the recent movement toward new materials are found parts manufacturers who are engaging in an intense "struggle to survive." Let us look at recent major movements in new materials.

Cooperation With Chemical Industry

According to Ryosaku Suzuki, director of the technology department of the Japan Automobile Parts Industry Association: "There is 'automobile engineering' but we have never heard of the term 'automobile parts engineering.' If there is one, it is concerned mostly with materials."

Mr Suzuki observes that the "technological renovation in automobile parts since 1955 has been mainly cultivated by chemists." Many materials in use today, such as glass,

synthetic resin, catalyst, and friction materials, are the products of the chemical industry. At GM, for example, it is said that 22 percent of its researchers are chemical engineers. It is not an overstatement to say that technological renovations in future auto parts will be created in cooperation with chemical technology.

Among the materials used for automobile parts, plastics have been most widely used in recent years. Depending on the parts, the use of plastics exceeds that of aluminum. The application is not limited to the interior and the bumper, for which plastics were already in use, but extends in recent times to functional parts.

For instance, NHK Spring Co Ltd, through Nitto Boseki Co Ltd, introduced an FRP continuous molding technology of Goldworthy Engineering of the United States and succeeded in mass-producing automobile sheet springs. Actual production started this spring. Because of this, the company was able to achieve a 50-percent reduction in the weight of steel sheet springs. Already in the United States, GM has been utilizing FRP sheet springs for some of its models and it is likely that other Japanese spring manufacturers will obtain the technology soon.

In addition, the utilization of resin for radiators and fuel tanks is underway at a rapid speed. At an auto show last fall, NTN Toyo Bearing Co Ltd exhibited a radiator weighing 30-40 percent less than conventional models by adopting FRP for the water tank. The company began commercial production of the new radiator this year.

Resin for Headlamps

Furthermore, among the materials for functional parts, one which will attract most attention in the future is the resin for use in headlamps. Resin is already used in most of the lighting fixtures, including the taillamps (except the light bulbs), and it is said that what is left are the headlamps.

The utilization of resin in the lens, in particular, will be the future issue. The present problem is that the lens undergoes chemical changes when heat is applied: it changes color and damages easily. In terms of safety at impact and reduction in weight (about 50 percent less), a lot of hope is placed on the realization of "all-plastic headlamps." Both Koito Mfg Co Ltd and Stanley Electric Co Ltd are very close to this goal and are actively engaged in joint development with the resin industry.

Strength Is One of the Issues

The major aim of the aplication of plastics for automobiles is, needless to say, the reduction of weight. The difficulty in terms of lack of strength has been overcome by the development of reinforced plastics, so that plastics are used also for functional parts. But the utilization of plastic for the automobile body, regarded as the most effective way to reduce the weight of a car, has not been realized. GM tried it once but has not commercialized it. It is said that because a plastic body, unlike plastic parts, has to take into account the matter of life and death in a collision and because plastics produce a great deal of toxic fumes at the time of disposal, the realization of a plastic body is delayed.

In sum, the utilization of resin has a great effect in terms of weight reduction but it requires, depending on the area of application, strength and durability and may create pollution problems if used in quantity. Therefore, many problems must be solved before its immediate utilization can be realized.

[23 Jun 81 p 6]

[Text] Development of Processing Method Is Needed

The utilization of new materials in automobile parts is, on the whole, a trend toward "non-metals." Of course, some parts must use steel because of durability, strength, or cost. However, in order to reduce the weight of cars further, which is the most effective way to improve fuel economy, lightweight materials must be used extensively. This is one of the future issues facing the automobile industry. But to accomplish this, the development of new materials as well as processing methods (such as the press) must be promoted.

Formerly, it was thought that aluminum would be used extensively to reduce the weight. However, due to unstable market conditions and difficulty in joining it to other materials, a wide application of aluminum in automobile parts faces many difficulties. The advantages of aluminum are that it is, first of all, a third as light as iron and steel, that it is processed easily, and that it has a beautiful finish. Because of this, aluminum is used in cylinder heads, oil pumps, crank cases, and pistons; in addition, it is used for decorative purposes as in sidings and in heat exchange devices such as the oil cooler. The area of aluminum application is expanding. Its application in bumpers, body sheets, and radiators is anticipated and the manufacturers are promoting research in these areas.

Aluminum Radiators Reduce Car Weight by 3 Kilograms

Regarding radiators, aluminum radiators were exhibited at last year's auto show. It is said that if aluminum replaces copper, which is used now, more than 3 kg can be taken off the car. Also, aluminum hubcaps, options in most cars, will see increased application as a fuel economy measure and will become a standard feature in all export cars. According to Topy Industries Ltd, the largest hubcap manufacturer, its "two-piece aluminum wheel" (rims and discs are manufacturered separately and then assembled) is 20 percent lighter than the conventional aluminum wheel. The company anticipates increases in OEM sales abroad as well as in domestic sales. For this reason, the company is in rush to complete a mass-production system in its Toyokawa plant (Aichi Prefecture).

In the United States, too, the automobile industry, as a part of its energy conservation measures, is actively engaged in applying plastic and aluminum to its automobiles. Early last year, the Japanese Light Metal Association sponsored a fact-finding tour of the United States in order to survey the actual status of the application of aluminum by the U.S. automobile industry. According to its report, the utilization of aluminum for functional parts is rather advanced in the United States; it is used in engine parts (Ford) and in the installation of aluminum radiators (GM). In the United States, the volume of aluminum used per automobile is expected to increase from 127 pounds in 1979 to 200 pounds in 1985.

In this manner, the utilization of "non-metals" for automobile parts, principally plastics and aluminum, is expected to increase in the future; however, when "total energy cost" is considered, plastics will probably take the lead. Aluminum, which in the past 10 years was used extensively, is now seen as having passed its "first flowering period." Its future is in the development of processing methods and

expansion of application by making it feasible to combine it with other materials. Of course, the disadvantages of plastics in the areas of heat resistance, flexibility, and processing cost have been pointed out. At present, however, these negative aspects have been improved upon significantly by developments in the processing method.

High Tension Steel Sheets Are Also Used

In the final analysis, the material most abundantly used in the automobile is steel. While both car and parts manufacturers are expanding the application of aluminum and plastic, they are also developing thinner body panels by using high-tension steel sheets. The latter, compared with ordinary soft steel sheets, cost 10 percent more but weigh nearly 20 percent less. Because of the high tension, the application of the sheet will be extended from the panel to the engine in the future.

Thus far, high-tension steel sheets are used in various frames, brackets, and bumpers. They are also used in parts for safety measures that absorb energy, such as shock absorbers. In the future, they will be used in engine mounts, arms, and chassis parts. At present, these three materials--plastic, aluminum, and high-tension steel sheets--are being used to reduce the car weight. The future direction of these new materials depends on how they balance out with cost and the manner in which they are used in parts. In addition, the parts industry is trying to develop new materials by combining these with magnesium and other new materials. Such combinations, as they improve durability, will attract attention in the future.

[24 Jun 81 p 7]

[Text] R & D Structure Is Reinforced

The manufacturers are enthusiastic about developing new parts using new materials. The fact that recently parts manufacturers have been reinforcing their R & D structure is an indication that they are acutely aware of the role of new materials in auto parts.

"In the 1980's, the quality of parts, in other words, the development mainly of light materials, will talk." So saying, Showa Seisakusho (shock absorbers) is strengthening its R & D at its Saitama plant. Already, using a new material for its coil springs used in shock absorbers, it has successfully reduced the weight of absorbers by 30 percent "while maintaining the previous strength and performance" (executive director Koji Sato). In addition, Tokiko Ltd has greatly reduced the thickness of the absorbers' protective pipe preventing stones from scattering. R & D to reduce car weight is now in full swing. Already in 1980, Diesel Kiki set forth a 3-year plan to establish a full-scale R & D structure. By investing about 3 billion yen in 3 years, the company hopes to consolidate the research facilities at its Matsuyama and Konan plants in Saitama Prefecture; the facilities will conduct wind-tunnel tests for car air-conditioners and develop weight reducting materials. At Atsugi Automobile Parts, too, the ratio of R & D investment to sales increased from the previous 2 percent to 3 percent.

Various reasons are given for the development of new materials for auto parts; in addition to the efforts to reduce the weight of cars discussed above, there are energy-saving measures seen in the popularization of diesel engines and turbo charges. The piston ring industry is involved in a series of new material developments in response to such changes in the engine structure.

The Nippon Piston Ring Co Ltd, anticipating a widespread use of small diesel engines in automobiles, successfully developed compound materials for power valve mechanisms, including tappets, locker arms, and valve sheets. In the valve sheet, for example, the company has replaced the previous stellite (cobalt alloy) with a compound of cobalt, nickel, and chrome. The compound, used only in friction parts, has brought down the cost while improving the durability of valve sheets. Through adopting these specially sintered parts for power valve mechanisms, the company is gaining confidence that it can cope with future emission control of diesel engines and with turbos.

Steel Ring Advances

On the other hand, Riken [Piston Ring Industrial Co Ltd] became the world's first manufacturer to use oil control rings, in anticipation of a widespread use of diesel engines. The majority of piston rings for gasoline engines use steel, but due to high speed, high load, and light oil, it was difficult to use steel in diesel engines. By combining steel rings, lubrication in diesel engines became smooth, and oil consumption was reduced by 40 percent. In the future, it is assumed that there will be further development of new materials that are durable and friction-free, particularly in the area of compound technology, for use in areas surrounding the engine.

With regard to the functional parts surrounding the engine, ceramic is one material whose research is now underway on a long-term basis. Ceramic is said to be the product of the "third material revolution," following those of metal and resin; its usage in terms of heat and corrosion resistance, is expected to expand infinitely. It is now used in diesel engines (cylinder and piston) and ball bearings.

Teikoku Piston Ring is currently conducting joint research on pistons with a leading ceramics manufacturer. The company spokesman says that "although it will take some time before full commercialization can take place, we will promote the research by fully taking advantage of the pressure-binding technology developed by our company." It plans to select a director and conduct a market survey on a full scale. The United States is also studying the application of ceramic to automobile parts, especially in emission-related parts, such as the gas turbine rotor and turbo charger; the application in the engine block is also under study, but has not reached the practical stage. In Japan, the only ceramic-applied product exhibited at an auto show several years ago was the piston. The future development of ceramic parts jointly in cooperation with ceramics manufacturers is noteworthy.

In the brake-related area, too, studies of new materials are underway. At present, asbestos is used for brakes, but since this material may cause cancer, the brake manufacturers are studying friction-causing materials to replace asbestos.

Magnesium, found abundantly in the ocean, is another attractive new material for reducing the car weight; however, it has many problems in terms of production technology, such as how to prevent fires caused by scraps.

Joint Development With Chemical and Nonferrous Industries

It is expected that research in new materials for automobile parts will push not only for weight reduction but also for improvements in various aspects of the automobile,

such as durability, combustion efficiency, emission and safety measures. In the future the Japanese parts industry, which is weaker than those of the United States or Europe in the area of basic research, must promote joint development of new materials with the chemical and nonferrous metals industries. At the same time, it must promote the development of welding and other processing technology.

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SCIENCE AND TECHNOLOGY

JAPAN, GERMANY AGREE ON [illegible] INC

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 965, 28 Jul 81 pp 1, 19

/Text/

The Japanese and West German Governments have agreed to launch a joint technological venture to develop a practical magnetic float-and-run super-speed linear motorcar.

According to the Japanese Transport Ministry, West German authorities and a Japanese delegation reached an accord last July 21-22 in Bonn.

The approach was made because of Japan's high level of technology, as demonstrated by two futuristic development projects in progress for more than a decade.

The West German Government is reportedly planning to develop soon the first West European super-speed magnetic railway transport system through the joint project on the basis of either of the two Japanese projects. One of the two projects, that of the Japanese National Railways, has progressed so well that JNR may start a revolutionary transport service before long.

The proposed train as scheduled by the Japanese, is not JNR's magnetic levitation type, but the other High Speed Surface Transport type developed with Japan Air Lines Co., Toshiba Corp., Hitachi, Ltd., and Mitsubishi Electric Corp. The quartet and possibly some other Japanese companies are likely to be named for the joint venture by the Ministry's Transport Technology Council after its current study to draft a guideline for development of such railway systems in Japan by the end of September to show to the West German side. In West Germany, three companies, including Thyssen Henschel, Kassel, known for its advanced studies on such systems, are expected to be named likewise.

JNR's magnetic levitation type, using liquid helium of extremely low temperature, is to make a special railway car or a train of them float as high as 10 centimeters above the tracks by utilizing the mutually repulsive force between a superconductive electromagnet and the tracks. The vehicle could run as fast as 500 kilometers an hour by the linear motor force at work all along the tracks.

In contrast, the HSST type floats only 1 centimeter above the tracks by proper electric current-controlled utilization of the mutually attracting force between an ordinary electromagnet beneath the vehicle floor and the tracks and thus speeded on by the linear motor action. Though the maximum speed attainable is between 300 and 400 kilometers an hour somewhat slower than the magnetic levitation type, it is more easily realizable at a lower cost and its conventional electromagnetic technology fits it for quick application to medium or short-range transportation purposes.

CSO: 4120/319

SCIENCE & TECHNOLOGY

SECRETS TO SUCCESS OF JAPAN'S AUTOMOBILE INDUSTRY SOUGHT

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 29, 30 Jun, 2, 4 Jul 81

[Article by Hiroshi Nonaka, staff reporter. For related items see JPRS L/9913 of 14 August 1981, No 48/81, pp 13-20 of this series.]

[29 Jun 81 p 11]

[Text] Automobile Electronics: Japanese Automobile Electronics Leads the World; Digital Indicators Are Appealing, But Unwelcome in Popular Models.

"Recently the term 'automobile electronics' is frequently heard, but the one used in displays (indicators) is a toy," says executive director Jiro Tanaka of Nissan Motors casually. Tanaka does not mean that Japanese automobile electronics technology is inferior. It is easier to understand his statement if we interpret it as words of confidence that, in terms of engine control and safety, the Japanese electronics technology is far superior to that of European and U.S. automobile manufacturers.

Automobile electronics is flourishing today. One gets the impression that it blossomed suddenly, but it actually has a long history. It was Chrysler Corporation (U.S.), which is facing a management crisis now, that first applied electronics to automobiles. In 1958, 23 years ago, Chrysler introduced an automobile equipped with an electronics control gasoline injection system utilizing vacuum tubes.

In Japan, automobile electronics appeared in 1961, when Nissan installed a diode AC generator in the "Gloria." In 1962, Toyota adopted an electronics control overdrive system for the "Corona," and for the next few years electronics competition continued between Toyota and Nissan.

It was in 1970 when the full-scale automobile electronics era started. It was when Isuzu Motors installed the first Japanese-made electronics control fuel injection system (ECGI) in its "117 Coupe." A year later, in 1971, Nissan and Toyota installed an electronics control fuel injection system in the "Bluebird" and the "Mark II," respectively; since then, the Japanese automobile electronics technology has advanced rapidly.

At present, the electronics technology used by Japanese automobile manufacturers are: electronics fuel injection system, electronics control carburetor, CD ignition

system, EGR control, comprehensive engine control system, and multiple cylinder conversion system, all engine-related mechanisms; antilock system, automatic brake, fixed-speed control system, and automatic door lock, all for safety measures; digital indicators showing estimated travel distance, required travel distance, and expected arrival time, all for convenience; in addition, there are the electronics transmission control and automobile air conditioner.

Of these, the display digital indicator tends to attract the attention of laymen. Recently, this digital indicator has often been cited as proof that an automobile is an electronics automobile. But, as Tanaka has said, it may be that utilization of electronics for a digital indicator is no more than a "toy" for automobile engineers. This is because the basic application of electronics should be in those technologies which take into consideration such functional aspects of the automobile as smooth ride, fuel economy and safety, as well as taking into consideration the human and environmental factors (Kiyoshi Matsumoto, managing director of Toyota Motors).

The recent application of electronics to the display area is partially due to the fact that its application in the functional areas has moved a step up. With the coming of the age of leisure, the users no longer regard the automobile "simply as a means of transportation, but also as a thing to enjoy" (Hajime Aida, MOTOR MAGAZINE). This too explains the popularity of "display electronics." Early this year, the West German commissioner of patents stated that: "In the area of introducing automobile electronics, Japanese automobiles far exceed Germany's," and this statement appeared in some newspapers. Certainly, it can be said that in the area of automobile electronics, the Japanese automobile industry is leading the world.

Recently, Japanese automobile manufacturers have begun to employ a large number of college graduates with degrees in electronics engineering. It used to be said that mechanics and designers were all that were needed for automobile manufacturers. Today, however, it is said that "an automobile is a union of mechanics and electronics, and nothing can be done without electronics and electric engineers" (Shinji Seki, managing director, Mitsubishi Motors; Seiichi Inagawa, executive director, Suzuki Motors). This view is possible simply because of the judgment that the era of automobile electronics will move further ahead in the future.

Having said that, it must be added that the application of electronics in the automobile is, for the time being, limited to full-size and luxury models whose production volume is small. Considerable difficulty must be overcome before electronics can be applied to popular models. The difficulty is not in technology but in the large gap that exists between the user's perception of luxury and popular models. According to a market survey conducted by the automobile manufacturers, the drivers of popular cars with under 1600 cc engines are of opinion that "expensive cars equipped with various electronics devices are not necessary. When the cars become too complex, driving and repairs become troublesome." They do not welcome electronics automobiles with open arms. In this sense, whether or not Japanese automobile electronics can move ahead in the future may depend on the strength of the users' needs.

[30 Jun 81 p 11]

[Text] Passion for Technological Renovation: Japan Is Number One in Renovative Technology; A New Rotary Engine To Appear This Fall--With Low Level of Pollution.

Toyo Kogyo Co Ltd plans to introduce a new rotary engine car this fall. The rotary engine, like the reciprocal engine, has four cycles, but instead of pistons that move up and down, it has a rice-ball shaped rotor which rotates.

In the 1960's, the world's car manufacturers were busy developing rotary engines to replace the recipro-engine. Especially devoted to this task was Audi NSU (now a subsidiary of Volkswagen) of West Germany, GM, and Toyo Kogyo. But it was Toyo Kogyo that first succeeded in developing a rotary engine. The "Cosmos Sports," introduced in May 1967 as the world's first rotary engine car, became an instant success.

The popularity of the rotary engine, however, declined rapidly during the latter half of the 1960's, due to pollution and fuel efficiency problems. GM, which had publicly declared its intention to introduce rotary engine cars by 1975, also suddenly announced its decision to terminate the plan. On the surface, at least, its reason was "the difficulty of emission control." Although we do not know the real reason, some Japanese automobile experts analyze that "GM was unable to solve both the emission control and fuel efficiency problems. Furthermore, in terms of basic technology, it was unable to take full advantage of the merits and uniqueness of a rotary engine." Even GM, which is said to hold the world's greatest technological development power, could not develop a practical rotary engine.

Even though it finally developed the first rotary engine, Toyo Kogyo also had to struggle with emission control and fuel efficiency problems. Because the rotary engine burns fuel at high temperatures, the proportion of hydrocarbon in exhaust fumes is great. There was always the problem of durability and fuel inefficiency. At one point, a decision had to be made whether or not to continue the research. Looking back, managing director Kenichi Yamamoto, the "father of the rotary engine," recalls: "We had already crossed the Rubicon. We had to continue even if we didn't feel like it. It meant that unless we pushed on it would destroy our company."

So Toyo Kogyo kept trying to improve the engine. By improving on the thermal-reactor and the catalyzer, and by changing the material for the apex seal of the engine, Toyo Kogyo was able to eliminate pollution and the fuel efficiency and durability problems which had been the technological obstacles. In this way, it succeeded in developing a new rotary engine where GM and Audi either failed or gave up. It is this new rotary engine car which will be introduced this fall. According to managing director Yamamoto: "If one does not forget the dream and endeavors to realize it with passion, new things will follow one after another."

As Yamaoto says, technological development concentrating on one item will, if pursued in earnest, produce various other new things. It will also affect the development of peripheral technologies. This was the case with the efforts to improve durability and the development of technology to control emission. For Japan's automobile industry, which had a late start behind Europe and America, there were a number of technological problems it had to overcome. Moreover, all of the basic technologies for automobile production were in the hands of Western counterparts. To catch up and beat the foreign competitors, the Japanese had no choice but to improve on the technologies developed abroad. Toyo Kogyo's success in developing the new rotary engine (basic patent held by Audi MSU) is a good example of this.

The same can be said of the recently popular AT (automatic transmission) cars. Although AT was conceived and developed in the United States, where "easy driving" is the greatest concern, the Japanese AT technology is now said to be superior to America's. Especially highly evaluated overseas is Toyota's AT, equipped with a four-speed OD mechanism.

Because of special mechanical features, AT's fuel efficiency is inferior to MT's (manual transmission). The fuel efficiency, however, can be improved greatly by raising the transmission gear ratio (the ratio of the revolution of the engine to that of the wheel; at top gear the ratio is 1:1) or by directly connecting the fluid drive of the converter. Based on these concepts, in June 1977, Toyota developed the four-speed OD-equipped AT whose gear ratio is higher than 1:1 (the "Corona's" ratio is 1:0.689). Two years later, in September 1979, Ford also developed a similar AT mechanism, followed by GM in October of last year. This means that America, which is the home of AT, is lagging behind Japan by several years.

Moreover, 2 months before GM could develop its own AT with four-speed OD, Toyota was already a step ahead with another technological breakthrough, a direct clutch type overdrive mechanism. In AT, the gear ratio changes automatically due to the fluid drive of the torque converter. In the clutch type OD, the transmission can be put into OD and, at the same time, the input and output aspects of the engine can be connected directly. In other words, because the "slipping" of liquid drive is eliminated, the energy transference efficiency can be raised and fuel efficiency improved.

This spring, this AT with four-speed OD mechanism was the recipient of an award from the Japan Machinery Association. It was the first award given in the area of automobile drive technology. The developer, director Akio Numata, says proudly: "Development of technology is fiercely competitive these days. It is extremely difficult for one technology to remain number one in the world for 2 years. Our At has been number one for 4 years."

[2 July 81 p 11]

[Text] High Quality Control: Differences in the Enthusiasm of Workers; European and American Wuality Control Inspection Tours to Japan Arrive Daily.

The following explains the secret of the high quality of Japanese cars: "The quality of Japanese cars is better than that of American cars not because there is a problem in the work attitude among American workers; nor is it because Japan's method of assembling automobiles is far superior technologically to that of the United States. Basically, the difference is the result of management attitude and policy aiming at improvements in quality." This is the opinion expressed by Professor Robert E. Call of the University of Michigan's Japan Research Center, in an article in the 16 January issue of "American Metal Market--Metal Working News."

In the article, Professor Call points to three reasons why Japanese cars are superior: 1) In Japan, the design work is done jointly by the technological design, assembly line, manufacturing, and sales staffs. All of them are actively involved in the design of a new car. 2) The relationship between the car manufacturer and the parts maker is strong and mutual. The car manufacturer cooperates with the parts maker so that the latter can supply high-quality parts. In this way the car manufacturer stresses quality control. 3) From the top management to the assembly workers, everyone does his part positively to maintain quality.

As we have seen, it was due to the untiring efforts of technologists that Japan's automobile technology became one of the highest in the world. But each individual improvement in technology does not in itself produce a superior car. As in the manufacture of airplanes, it is the "comprehensive industry" which produces the cars. All 33,000 parts must be made precisely and assembled without a hitch. No matter how superior a part is, a superior car cannot be built if it is not assembled correctly.

A factor contributing to the superiority of Japanese cars, along with that of technological advances, is the high degree of quality control throughout the production process. What happened was that "the quality control method which was developed in the United States flowered in Japan" (executive director Masatoshi Morita of Toyota Motors). At present, there is a continuous flow of American and European fact-finding tours to Japan, inspecting how quality control works in Japan's automobile industry. Ford and UAW officials formed a joint team; they were apparently impressed with Japan's production control system: "In the future, the United States must learn from Japan" (Donald Efflin (?), vice president, UAW).

One of the best-known features of Japan's quality control system is the "quality circle." The circle is composed of about 10 assemblyline workers. They meet two-four times a month to discuss their problems. In Toyota's case, for example, the average worker submitted 17.8 suggestions last year, and 90 percent of them were adopted. In contrast, the average worker at GM submitted 0.84 suggestions last year, and only about 22 percent of them were accepted. There is, then, that much more difference in the attitude of workers toward quality control.

When executive director Masatoshi Morita of Toyota Motors toured the Australian automobile industry last year, he came upon shocking data. In Toyota's Australian plants, "Toyota Manufacturing Australia" and "Cheese [phonetic] Toyota," the employees came from 15 different countries and their average annual rate of leave of absence was 70 percent. It was not something that could be easily understood by the Toyota headquarters, where its workers are all of one nationality and their leave of absence rate is 2 or 3 percent. It was Morita who said: "Under these conditions there can be no skillful quality control."

On the contrary, we can say that a society like Japan's is unique. This is because no developed nation has a homogeneous population like Japan, not the United States nor the EC, where workers come from various countries. For example, in the case of the world's largest automobile parts manufacturer, Bausch (W. Germany), 13 countries are represented. The average rate of absence at Bausch is 40 percent. It is said that the quality of West German products has come down; perhaps the reason lies in the above figure.

In any case, one cannot speak of the superiority of Japanese cars without considering the fact of quality control. At the base of this quality control, as Professor Call points out, is Japan's better "management policy" and the homogeneous work force which understands such a policy and whose labor is of top quality. In this respect, it can be said that "a Japanese manufacturer is surrounded by factors which enable the management to make long-term policies" (executive director Masatoshi Morita; managing director Shinji Seki of Mitsubishi Motors).

In other words, many U.S. counterparts, whose performance may be checked every quarter and who may be relieved of their positions, "are unable to look at things from a long-term perspective because their priority is with short-term profits. This situation destroys continuity in management policy and makes it impossible to maintain good quality control" (Masatoshi Morita). The superiority of Japanese cars may also be explained by the fact that Japanese management is "stable."

[4 Jul 81 p 6]

[Text] Development Posture Questioned: What Is Decisive Is Steady Effort in the Pursuit of "Makunouchi Lunch".

Vice president Junichi Ono of Daihatsu Motors is an avid reader. Recently, he chanced upon an article in an economic journal which greatly impressed him.

The article was about various past and present inventions and discoveries. "The first is the Columbus type, who invests huge capital but the result relies much on chance. The second is the Yuichiro Miura type, who skied down Mt Everest. He is the type whose imagination is impressive but the catch is that no one is interested in seeing things done the second time. The third is the Naomi Uemura type, who reached the North Pole by sled. This type requires extremely severe and painful self-discipline, but the success rate is high because of the cooperation of those around him." The writer is Masanori Moritani, the chief researcher at Nomura Research Institute.

"If we can extend this story to technological development, the type most reflective of Japanese style and also the most ideal is the third, the Uemura type." This, according to vice president Ono. The characteristics of the Uemura type are that the goal is well-defined, perseverance is required, and the result is not determined by chance. May not all of these be found in the history of the development of Japanese automobile technology?

As we have seen in this series, Japan's automobile technology began far behind that of Europe and the United States. The basic technologies were all held by foreign countries and in the midst of this difficulty Japan had only to improve on existing technologies. The goal of "catching up with Europe and America and then surpassing them" was a clear one. The targets of increased durability and improved emission control, responding to the demands of the time, were also clear. An image of a technological developer, different from the Columbus type who relies heavily on chance and the Yuichiro Miura type who gambles on an idea, emerges clearly.

During the 1980's it is unmistakable that "technological force" will control the world automobile competition. In this situation, what the Japanese technologists who succeeded in producing the world's greatest cars fear most is the development power of GM. There are those in management positions who openly admit that the "present Japanese cars are like the Zero fighters. If the United States becomes serious about developing cars, it would be like the Grumman fighters destroying the Zeros."

There are, of course, those who respond to such a statement by saying that "Japan's reserve of know-how is completely different then and now. No comparison is justifiable" (executive director Jiro Tanaka of Nissan; managing director Kiyoshi

Matsumoto of Toyota). This is the general response. Even so, to the news that GM will spend 4 million dollars to develop small cars between 1980 and 1984, many Japanese would say that "in all honesty, it is somewhat threatening" (same).

In addition to the J-cars which were released in May, GM hopes to market even smaller S-cars in 1983. It is beginning to define its targets clearly, and in that respect, GM's style is approaching that of Naomi Uemura. In terms of design, improvement, and manufacturing technologies, the Japanese cars can be said to be at the top. It cannot, however, be stated categorically that Japan's superiority will continue if GM and other Western automobile manufacturers were to get serious about pioneering new technologies.

In order to maintain this superiority, Morita urges a "technology transfer." Managing director Takeshi Nakatsuka of Isuzu Motors emphasizes the "combining of new technologies." The thinking behind this is the production of cars that meet the demands of the time by introducing new technologies actively, applying them and combining them. Almost all top-level technologists in Japan's automobile industry agree with Morita and Nakatsuka. Their opinions tend to be negative regarding technological developments that are based totally on new ideas (Yuichiro Miura type).

In the background is the view that the automobile as a "machine" demands "an extremely high degree of safety" (managing director Shinji Seki of Mitsubishi Motors). Danger accompanies the adoption of a totally new contrivance and systems. So "it would be much more effective and important to produce improved products by transferring existing technologies of the most advanced type, such as those of space engineering" (Morita, Ono, and Nakatsuka). If so, it may be that the Japanese, who are said to be superior in applying technologies rather than in developing them, are a people most suited for developing and improving automobile technology.

According to Nakatsuka: "The goodness of a Japanese car is like the goodness of a makunouchi lunch [assorted meats, fish, vegetables, and rice arranged in a box]. It is pretty to look at; it is delicious and highly practical. It is unlike the Western lunch, where there is only one entree. It has a lot of good things in one box. They are the softwares." So it seems that in many items--power steering, power windows, electronics, etc--the Japanese car is a conglomeration of many technologies, and such a collection of technologies is evaluated highly by the world. The development posture we have seen thus far constitutes the basic line the automobile industry must follow during the 1980's.

But as we have also seen, Japan "is not necessarily ahead of Europe and America" (Ono) in such basic technologies as high-speed performance. All of the top world technologies which Japan has developed to date "can be developed by others" (tanaka). It is necessary to realize that the footing of the world's most excellent cars is not at all stable.

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SCIENCE AND TECHNOLOGY

MAJOR ENTERPRISES STRIVE TO DEVELOP NEW PRODUCT LINES

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[Excerpts] Low growth has taken hold, as has the high cost of resources and energy. A wall of economic friction is rising precipitously even in export products which are based on the formula that high-production technology with quality control as its axis equals low cost. In such a situation, the path of survival for Japanese industry is simply high technology and original products. That is to say, it is embodied in the strategic commodities of each enterprise. Choosing 15 [only 9 are included in these excerpts] representative companies, I have tried here to explore by means of what kind of goods and in what fields each of these Japanese enterprises is now trying to find a way out of these difficulties.

Communications Related Materials: Diversified Development from Polymeric Materials of Machinery--Toray Industries Inc

Toray's basic posture is: "we will offer material to the electronics industry and communications-related industry based on polymer chemistry and miniaturized processing technology accumulated thus far in synthetic fibers and plastics." (Chairman Masahiro Ito)

Toray has made furnishing communications-related materials the nucleus, and because "one must know hardware in order to give after-sales service" (chairman Ito), it has extended its business to the machinery field, such as the production of high-speed printers and measuring instruments, and the sale of personal computers of America's Apple Company. It is now in the midst of building up the mood for sales, putting up posters which read "Californian Apple" in the subway stations of the Tokyo area.

Toray's electronics materials and communications-related materials and machinery can be classified as: 1) polyester film (material for VTR tapes and audio tapes); 2) electronics materials (polymer materials such as photosensitive resin and electron resists); and 3) machinery (printers, measuring instruments and personal computers).

Of these, polyester film has already been nurtured into a large tree. It boasts an estimated 80 percent share of VTR tapes and an estimated 60 percent share of audio tapes. Toray's competitive power in quality and cost is international in that its products are used even by U.S. manufacturers, replacing DuPont. Even domestically, Toray has a duopoly with Teijin, Ltd; film manufacturing technology and polymer quality were the decisive factors.

Toray has not publicized what its polyester film sales are, but in the film division which includes polyester film (monthly production capacity of 2,200 tons) and polypropylene (packing materials are the leader; monthly production capacity, 1,200 tons), sales were 53.7 billion yen (FY-80). Its target is to sell 100 billion yen in the film division 5 years from now, in 1985. To do so, Toray is now enlarging the polyester film facilities, which have a monthly capacity of 900 tons; the monthly production capacity will be 3,100 tons by the end of 1982.

Five years from now, polyester film is going to be Toray's largest division in terms of profit as well as sales.

Compared to polyester film, electronics materials have just sprouted, only having "sales of several billion yen" in 1980. (Koga) As for the scale of the operation, the present goal is sales of 10 billion yen in 1983. Ten years later, in 1993, "a grandiose target has been set for sales of 100 billion yen in electronics materials and machinery, and an operating profit of 30 billion yen." (Ito)

While mass market goods similar to polyester film cannot be expected, there will be an accumulation of small, high-technology goods. There is a staff of about 100 in production, R & D and sales, and there are various products, such as transparent conduction film, scratch-resistant film, polyamide film, heat-resistant insulating varnish, photosensitive resin for use in integrated circuits (photoresists), electron resists, elastic connectors, IC film carrier tape, film for use in additive plating and PTFE copper plating.

As for the target, materials used in integrated circuits are central. Electronic chemicals which combine the electronics technology of electronics manufacturers with Toray's polymer chemistry are in the direction being promoted.

Electron resists developed in cooperation with ultra LSI technology can be said to be typical.

Electron resists are a polymer material capable of using an electron beam instead of a light beam for integrated circuit pattern formation. Their development has been highly rated as a step toward the realization of ultra LSI's.

Because electronics materials are a vanguard industry in which technological progress is rapid, there is the nagging anguish of: 1) investment and technology become antiquated quickly; 2) a blunder in the direction of development would be fatal; and 3) because it is a chemical manufacturer, its ability to evaluate electronics products is weak.

In the machinery field, the scope of sales was 6 billion yen in 1980, and the target for 1983 is 20 billion yen.

The American Apple Company's personal computer has not sold as originally planned, since Japanese power, such as that of Nippon Electric Company Ltd, Hitachi Ltd, and Sharp Corporation, is strong and there has been a succession of companies newly joining the field, such as Fujitsu Ltd. Nevertheless, with Apple's plentiful software as its weapon, Toray is eagerly expanding, setting up 50 stores throughout the country.

As for printers, Toray is narrowing itself down to an ultra-high-speed laser beam Kanji [Chinese character] printer, and at present is in the midst of developing a much higher performance printer based on technological cooperation with Fujitsu. It is stated with confidence that it has a machinery shop at the Shiga site, and "the toner which is the lynchpin is a job for the chemists." (Ito) Until now total sales have been 90, so the efficiency of mass production has not yet appeared, but that is hoped for in the future.

Electronic Chemicals: Rapid Growth of Resists and Pressure-Conduction Rubber--Nippon Synthetic Rubber Company

Nippon Synthetic Rubber Company's electronic chemical projects are well under way. There are great expectations since "in addition to growth, there is a high added value and they are technology-intensive products which cannot be initated." (President Shinnosuke Katsumoto)

The scale of electronic chemical sales is still 1 billion yen. With total sales of 165.7 billion yen (March 1981), that is insignificant. However, in 6 to 7 years from now, growth to a 10-billion-yen business is anticipated. Moreover, a contribution to profits is anticipated since "the profit ratio is extraordinary." (Katsumoto)

The company's electronic chemical projects have made pressure-conduction rubber and photoresists the two pillars.

Pressure-conduction rubber is this company's original development and has been sold since February 1978. Besides increasing the conductivity of the original conduction rubber, it is a composite material of metal particles and silicon rubber which changes rapidly from an insulating state to a conducting state by the use of pressure stimulation, such as touching with the fingers.

By employing the special characteristics of rubber elasticity and pressure-sensitive conductivity, it is used for soft-touch switches and keyboards. Besides being used in calculators as thin type touch switches, it has uses in all sorts of home electrical appliances with built-in microcomputers, sound products, communications instruments, measuring instruments, cameras, watches, automatic doors, office computer keyboards, POS and diagram input units; the demand has recently extended to word processors.

At present, Nippon Synthetic Rubber is the exclusive supplier of pressure-conduction rubber in Japan. It is said that as soon as it hit the market, inquiries rushed in from more than 2,000 customers. Because it is a totally new function material, not only will the company sell the product, but it will have to plan and design in cooperation with users. However, because the relative cost is high, there are restrictions limiting the uses which could sufficiently absorb the cost.

In response to the increased demand for pressure-conduction rubber, facilities at the Yokkaichi plant were enlarged this April (monthly production increased from 15,000 to 30,000 sheets, each sheet being 100 square centimeters).

On the other hand, microphotoresists began selling in February 1979. This is a material necessary for making circuits, such as IC's and transistors. It is used

in the process of making a circuit by applying a photoresist of about 1 micron to the silicon wafer, printing by exposing ultraviolet rays through portrait film and finally etching (corrosive etching).

Research and development started in 1969. At that time, Japan's photoresists were almost completely monopolized by Kodak products through Nagase and Company Ltd. But since there were requests from domestic users, Tokyo Oyo Kagaku Kogyo Ltd went into domestic production in 1970. It successfully expanded its share after that, and Nippon Synthetic Rubber decided to join the field, given the background of demands for a "guaranteed stable supply" (Akira Sekimoto, director of Nippon Synthetic Rubber Company Ltd and new projects director) from semiconductor manufacturers, the users of photoresists.

Nippon Synthetic Rubber is the world's only total manufacturer of photoresists from the raw materials of isoprene-monomer. There are both positive and negative photoresists. At present, Tokyo Oyo Kagaku Kogyo leads the field in the negative type, the leader in Japan's market, with a little less than a 90 percent share. However, Nippon Synthetic Rubber has taken about a 10-percent share only 2 and 1/2 years after beginning sales.

Furthermore, in answer to increased demand, there are plans to expand the photoresist facilities at the Yokkaichi plant, with an October completion date scheduled. The future goal is to secure a 30-percent share of the domestic market. Looking at the semiconductor industry's rapid growth, the growth of photoresists will also probably be great.

Nippon Synthetic Rubber has just "become a resist manufacturer which has finally come of age." (Sekimoto) Because they are for the semiconductor industry, which is achieving rapid technological innovation, even for Nippon Synthetic Rubber, there is the demand for technological development corresponding to the electron beam and X-ray exposure.

"We are hoping that the electronic chemical field will not be limited to only conduction rubber and resists. We are nurturing them into a large tree, and are hoping to expand electronic chemical materials as the new product group for the future." such as marketing thin film insulation material for semiconductors (cyclic polybutadiene) this April. (Sekimoto)

Power Conservation Electrolysis System: Aiming at 100-Billion-Yen Market with 30-Percent Electricity Conservation--Asahi Glass Company Ltd

Asahi Glass has started an electric power conservation electrolytic soda process/AZEC system. At the end of June, the Chiba factory was in operation using this system with a monthly production of 64 tons (64,000 amperes). Even though it is only 64 tons, this is just one part of the actual plant, and if the various parts were linked together, it would be considered a large-scale plant.

It is not an exaggeration to say that the AZEC system is presently being observed worldwide. Many reasons for this can be listed: 1) compared to the mercury method, there is an electric power savings of more than 30 percent; 2) the quality of the soda is the same as the mercury method; 3) the soda concentration is heavy, 40 percent; 4) it is nonpolluting; and 5) conversion from the mercury method is easy and low cost.

AZEC is an acronym for Asahi Zero Gap Cell, and as the name indicates, its specific feature is that the spacing between electrodes is extremely narrow. Of course it is not just that. The ion-exchange membrane which is the heart of the cell has fluorocarbon resin as its base and has an ion exchange function by means of a carbon acid radical group. The anode is a general oxide ruthenium derivation, but the cathode is an Asahi Glass original. The electrolytic cell structure is also an original structure, such as the automatic filter press.

Because of all this, the electric power used per ton of soda is kept down to 2,000 kWt in the AZEC system. This is a marked energy conservation compared to the more than 3,100 kWt for the existing mercury method and themore than 3,200 kWt for the asbestos diaphragm method (including steam energy for increased concentration).

At present, the SPE method (solid polymer electrolide) of G.E. and Italy's Dinola has attracted worldwide attention, but even here, energy consumption is about 2,300 kWt. Moreover, SPE is still being developed, and Asahi Glass' AZEC has a great lead.

At present, when energy costs are skyrocketing, operating costs are more important than equipment costs. However, it is said that AZEC's equipment cost "will not be higher than the cost of the present ion-exchange film method." (Masao Nagamura, managing director) Moreover, a strong point is that a multipolar electrolysis for users just getting established and a single pole electrolytic cell for those converting from the mercury method are being developed.

It is also a strong point that conversion in which existing equipment, such as rectifiers, can be appropriated, can be rather cheap.

It is said that at present, for a facility with an annual production of 100,000 tons, the cost for a newly established facility would be less than 8 billion yen (equipment cost for the existing ion-exchange film method) and the cost for conversion would be about 4 billion yen.

The sodium hydroxide business has been promoting conversion from the mercury method to nonmercury methods, such as the diaphragm method and ion-exchange film method) since 1973 in order to avoid mercury pollution. Asahi Glass itself, investing 20 billion yen, had already converted to the diaphragm method, and it is ironic that it cannot completely introduce its own AZEC system. However, "we will adopt it completely in all facility expansions and overseas." (Nagamura) Likewise, in the entire domestic business, out of an annual production capacity of 4.5 million tons, 1.65 million tons still have not been converted from the mercury method, and worldwide there actually exist mercury method plants totalling 42 million tons.

Asahi Glass is aiming at the demand for conversion of these plants (domestically, the schedule is to complete the secondary manufacturing method conversions by the end of 1984) and will try to sell large numbers of AZEC. In particular, it plans to launch an attack primarily on manufacturers marketing soda (because private consumption for use in paper manufacturing and the like is of low concentration), making a high-concentrate soda their weapon.

PPG and Olin in the United States, England's ICI, and West Germany's Ude have successively decided to adopt AZEC, not to mention the fact that Kashima Denkai Ltd, an affiliated company whose major stockholder is Asahi Glass and which has Japan's largest capacity (monthly production, 23,533 tons), has already decided to convert to the AZEC method. That is a good start.

It is anticipated that 5 years from now conversion and expansion will total about 363 billion yen annually--270 billion yen in plants, 80 billion in film and 13 billion in knowhow. Because these figures are premised on a growth in soda demand at an annual rate of about 5 percent, this seems to be an exaggeration. But "as for Asahi Glass' business, we would like to get 100 billion yen." (Nagamura)

There is no doubt that ion-exchange film is an important technology for low-temperature, low-pressure processing, which is a problem for the chemical industry, and the dream for future development is great.

Machine Tools for Aircraft: No Rapid Growth But Modernization Is Great--Toshiba Machine Company Ltd

A profiler is a high-level, specialized machine tool which automatically cuts and files aircraft parts in three dimensions. Unlike the pre-World War II propeller airplane era, in the present jet age the manufacturing process for airplane parts has changed fundamentally, and cutting has started to occupy an extremely important position.

In the pre-war manufacturing methods, the process of cutting, bending and riveting was the main process, but the demand for performance strength in jets has increased markedly. The process of cutting the metal plates, bending them and welding or riveting is insufficient for jet airplanes; there has been a change to the manufacturing method of making parts, such as the ribs, by shaving or cutting the aluminum and titanium alloy stock.

Likewise, the contradictory characteristics demanded are to use lighter and fewer materials but to make it stronger. Because of this, the outer shell uses rather thick materials, and in order to lighten it, the unnecessary part is cut away, leaving it full of pockmarks. In this sense, cutting is the important factor. In the case of jet parts, 90 percent of the original stock is removed.

Because of this it is necessary for the machine tools to be ultra-high-speed-revolution tools and to control many axes simultaneously. Toshiba's profiler controls a maximum of 5 axes simultaneously. It has experience in controlling 9 axes simultaneously in a large cutting machine for screw propellers. It is quite expert in revolution speed and simultaneous multiaxes control technology.

But because it had no cutting process knowhow, Toshiba signed an all-inclusive import contract with France's TMI (formerly Forest). TMI was originally an airplane parts manufacturer, and since it dealt with the manufacture of profilers, it had accumulated abundant processing knowhow. Due to the mass production difference, machine tools are more specialized in the United States. In contrast, they are relatively diverse use machines in Europe. It can be said that since Japan is also a country which can be put in the same category as Europe, it stands to reason that European-style know-how would be introduced.

But Toshiba's profiler is a machine tool for cutting aluminum; one for cutting titanium alloy has not yet been manufactured.

In any case, it cannot be said that this machine is one which is linked to any future rapid increase in demand. In Japan's case, it can be seen that the scale of the aircraft market is a little less than 300 billion yen annually, and within that, the market for aircraft parts machine tools is no more than several billion yen.

Because of the small size of the aircraft market and the instability of demand, there are only 15 machine tools devoted to aircraft, and among those, only 5 are profilers. It seems than many are using a combination of ordinary machine tools and large-scale MC's for aircraft use.

The record of orders this company has received over the past several years shows a total of seven--four for the United States, one for Australia, and two for domestic use. All are being used for the manufacture of private aircraft parts, with the YX airplane being central. Now, however, since the time is approaching when the world's private airplanes''which are said to number about 6,000--will be replaced with new, midsized aircraft, and because private aircraft manufacturers, primarily American, have not made plant and equipment investments for 10 years, there are strong indications that from here on, it will be time for full-scale plant and equipment investments. In that sense, the profiler market has a chance to expand.

One large-scale machine tool costs 200 to 600 million yen, but looking at the scale of this company's sales (83.9 billion yen in the previous period), sales of machine tools cannot be said to be large. Toshiba is newly joining this field in response to goal number 2 of the following three development goals of the company: 1) develop highly the present machines; 2) develop highly the modern technology; and 3) develop a future technology. Likewise, in terms of integrating transportation, the profiler holds a position of high priority for management since it is a powerful weapon in the sense that it is joining the growing aircraft market, which comes right after ships and automobiles.

Energy Conservation Ships: 40-Percent Fuel Cost Reduction with Comprehensive System--Nippon Kokan KK

The energy conservation era is about to arrive for specialized carriers such as iron ore carriers and the like. Following Nippon Kokan's announcement of its advance into energy conservation ships in its 37th shipbuilding plan (construction to take place in 1981), Kawasaki Heavy Industries Ltd and Mitsubishi Heavy Industries Ltd also spelled out their plans.

Indeed, Kawasaki and Mitsubishi will make energy conservation ships using conventional low-speed diesel engines. In contrast, Nippon Kokan will adopt medium-speed engines which are now technologically justifiable, and as a matter of fact its aim is to have these engines become the main current of energy conservation ships. This contrast is a good point.

There was a price increase in bunker oil after the first oil shock; this was the background in which the idea of energy conservation ships appeared. Prior to 1973, bunker oil was stable at $14.15 per ton, but by the end of last year, the price had increased to an average of $220 or so. Now the price of bunker oil has dropped below $200. However it is best to look for price increases instead of decreases over the long term.

In any case, with such a great increase in the cost of bunker oil, 40-50 percent of the marine transportation costs will be consumed by fuel costs.

Before the oil shock, the rationalization that transportation cost reduction depended on making large-scale ships was the decisive factor; but at present, fuel economy

alone is the decisive factor in transportation cost reduction. The basic idea of energy conservation ships is that even though the price of a ship more or less rises, a sufficient commercial profit can be realized if fuel consumption is lowered by making the cabin smaller and decreasing the speed.

However, in an energy conservation ship, first of all an energy conservation effect cannot be fully expected unless the following are collectively adopted: 1) lowering the engine fuel costs is, of course, a major premise; 2) improvement in the propulsion efficiency by using low-revolution, large-diameter propellers; 3) use of an exhaust heat recovery system; and 4) decrease in the hull's resistance by means of its shape and the paints used.

Nippon Kokan began researching how the next raw materials carrier should be built in the fall of 1979, and the result was the development of an energy conservation ship based on the ideas listed above. The 37th shipbuilding plan provides for building a 140,000-ton combination iron ore and coal carrier and an 86,000-ton freighter.

In the 140,000-ton iron ore and coal carrier, a 15,000-horsepower medium-speed engine is used; compared to a conventional ship, the engine's output is some 10 percent smaller. The fuel consumption rate drops to 132 grams per horsepower per hour (existing carriers consume 156 grams); as a result, it is possible to achieve a 24-percent reduction in fuel consumption. The medium-speed engine operates at 400-700 rpm's; efficiency in the propulsion has been improved by decelerating the rpm's with gears and dropping the number of propeller revolutions to 62 revolutions.

A variable pitch propeller is used in order to be able to reverse the ship without reversing the engine's revolutions, the propeller diameter has been enlarged to 9 meters, compared with 6-7 meters for existing propellers.

At the same time the propulsion has been made more efficient, an exhaust gas economiser generating system has been adopted whereby steam is generated by high-temperature exhaust fumes (350 degrees Centigrade) which were formerly expelled outside, and the steam turns the generator. Diesel generators were expressly taken on board conventional carriers in order to furnish all electric power and since these generators will no longer be needed, the energy savings effect is great.

Besides this, Nippon Kokan is using a system in which a motor is attached to the propeller shaft and electricity is generated by means of the shaft revolution power, and an exhaust heat use system which uses engine coolant that has been heated to 80-90 degrees Centigrade for heating the ship.

Nippon Kokan is taking carefully-thought-out energy conservation measures, such as designing the hull in a highly energy-conserving efficient shape, and then painting the hull's outer shell with a paint that offers little resistance and makes it difficult for living organisms to attach themselves.

As a result of these various energy conservation measures, approximately a 40-percent fuel reduction compared to existing ships is expected; the energy conservation effect is exceedingly large. The ship's cost rises due to enlarging the propeller's diameter and use of deceleration gears, but when the energy conservation effect is this great, the merit of reducing operating costs will more than compensate for the increase in the ship's cost.

Various specialized carriers which were built prior to 1973 will become superannuated with the passage of time, and it will be time to build alternative ships. The boom in energy conservation ships is yet to come.

OA Machines: Becoming Aggressive with Kanji Knowhow and Integrating Power--Toshiba Corporation

Toshiba's annual turnover exceeds 1.5 trillion yen, while its strategic products are OA machines whose sales do not amount to 100 billion yen. Toshiba has several development pillars, such as nuclear power, defense and ME, but among them, OA machines, whose growth is greatest, are the central point.

The office automation machine market has achieved rapid growth since attention has been given to the administrative division's rationalization that it is sharply behind with 200,000 yen when compared to a manufacturing field where per capita equipment and facility investment amounts to 6 million yen. This thinking is heightening the awareness that this is an important field which will influence an enterprise's competitive power in the future; and manufacturers of heavy electric machinery, light electrical appliances, communications equipment and office machines are joining the field one after another. It is taking on the aspect of an overheated market.

Given such a situation, Toshiba plans to take OA machines and vigorously build them up as a key division of its electronics strategy. That is because it is recognized that "an alternative market to large-scale computers is pivotal, and OA machines and distributed data processing machines will grow." The sale of large-scale general-purpose computers has already been transferred to Nichiden Toshiba Information System, and importance has been shifted to an OA machine strategy with small- to medium-scale computers as the nucleus.

Toshiba's OA machines are not only the industry's largest in sales but also the machine composition as well balanced; likewise, a specific characteristic is that Kanji processing is also possible. In data processing, Toshiba has completed a lineup extending from simple function office computers to high-performance machines which can connect up to 32 work stations. Moreover, putting importance on Kanji processing, such as Kanji display and Kanji printing, has appealed to customers. Sales for the 1981 March quarter amounted to 4,400 machines and 21 billion yen.

On the other hand, there has been a high growth rate for facsimiles, which are the core of the new business communication system. At present, they have moved from the G-II type to the high-powered G-III type; and since 1980, Toshiba has started exporting OEM to all of Western Europe. The previous period's sales were 12-13 billion yen. The previous period's sales of photocopiers, the representative of OA business machines, were 50 billion yen. And while the photocopier is Toshiba's largest scale OA machine, its growth rate is dropping.

Kanji processing knowhow, which has been accumulated over a 10-year period, is helpful in word processors, to which Toshiba is now giving the most emphasis. Toshiba's word processor holds first place in the industry, although the amount is small--1,040 machines and 4 billion yen in 1980. Its growth potential is extremely great.

The plan is to make 6,300 office computers in 1981 (43 percent increase) since it will, with almost no export record, aggressively export machines in the $6,000-$7,000

class to Europe and the United States this year. Toshiba figures on a 30-40 percent increase in facsimiles. This has strong implications for photocopiers.

There has been a boom in Japanese word processors, with sales of 2,100 (more than double); one reason is that Toshiba committed itself to a low-cost product.

OA machines continue their high growth, but Toshiba is aiming next at the personal computer field (business personal computers), which it seems will grow rapidly from now on. Since January 1981, it has started selling the machines at more than 1.3 million yen each (actual sales were 500 in the March 1981 quarter), but it plans a substantial increase in FY-81. This fall, it plans to vigorously cultivate the personal computer field, such as starting to sell personal computers in the smaller 200,000-300,000 yen class through the home appliance route.

In personal computers, Toshiba is exerting itself in the development of software through its affiliate company, Nihon Business Automation, and is earnestly wrestling with opening up the latecomer personal computer market. Moreover, Toshiba is aiming at an integrated system incorporating computerized information system files and the like.

Even though the OA machine market has a high-level growth, competition has intensified, with a rush of new companies joining the field.

Toshiba is making full use of semiconductor technology, such as microcomputers and LSI's, and is going to exhaustively pursue a product differentiation by means of improving the dependability and operation of its machines. There is no doubt that Toshiba will look for the direction that makes the best use of its unique knowhow in Kanji processing cultivated over a 10-year period.

Interferon: Trend Toward Genetic Recombination Strengthened--The Green Cross Corporation

The antiviral drug interferon (IFN), is called a "new miracle drug." A worldwide intense development competition is unfolding over it. At present, the establishment of a mass production technology and research and development to decide on which diseases it is most effective are being announced simultaneously. The Green Cross Corporation, a leader in this field, will not necessarily be able to precede others in its commercialization. The rapid development of genetic recombination, which is said to be the most likely technology for mass production, has caused an even more chaotic situation.

IFN is a glycoprotein which impedes the propagation of a virus which has invaded the organism. It is said that IFN is broadly effective on such viral infectious diseases as influenza, poliomyelitis, hepatitis and leukemia. It is reported that, like a hormone, it also has the function of fine tuning the orgamism when used in very small quantities and of controlling the division of normal cells and tumorous cells. At this time, three kinds--α, β and γ--have been discovered, based on differences in antigens and molecular weight.

Green Cross promptly started wrestling with IFN commercialization in the late 1960's and early 1970's. Green Cross turned its attention to the practical applications of white corpuscles (leukocytes), which had been neglected and raw materials, which is

a strong field for Green Cross. As a result, it has moved ahead in the development of IFN-by the extraction of white corpuscles and the floating cell cultivation of lymphoblastoid cells which cancerize the white corpuscles.

As a matter of fact, this May it boldly applied to manufacture IFN--derived from white corpuscles--limiting manufacture to that indicated for viral corneitis and conjunctivitis. It was the first time in the free world that a license was requested to manufacture IFN as a pharmaceutical.

However, there is a raw material bottleneck in white corpuscles and lymphocytes, and there is difficulty in mass production. A remarkable effect was indicated against corneitis and conjunctivitis with several million units per patient, but it is said that with type-B hepatitis, 100-200 million units are necessary; and 200-300 million units are needed for cancer. The difficulty of guaranteeing mass production has reduced the extent of clinical applications.

Moreover, a research report appeared recently stating that the γ type is superior in its anticancer nature. A succession of prominent enterprises have announced an intention to develop IFN using genetic recombination, which is a superior method for mass production.

Based on these changes in circumstances, Green Cross started to greatly modify its track at the end of last year. It has shifted importance to the genetic recombination method, and as one step, it set about building a system capable of offering all three kinds of IFN clinically, incorporating purchases from outside.

In genetic recombination, Green Cross entrusted research on yeast fungus variations which create IFN-γ to America's CRI (Corroborative Research Incorporated), a company specializing in biotechnology. It is a little late, but receipt of IFN-γ is expected in August. At the same time, it is in the midst of advancing research with its own technology.

Moreover, in August it entered into a contract with Bristol-Myers, a major U.S. pharmaceutical company, for mutual exchange of manufactured fungus. Both are at the stage of having acquired a firm footing in mass production; Green Cross will provide γ-type produced bacteria and Bristol-Myers will offer α-type and β-type produced bacteria. "It will take at least 6 months to decide the contents of the contract" (Chairman Ryoichi Naito), but if all goes according to schedule, next spring it will be able to develop them all with the genetic recombination method.

Until then its posture is to fill the void with overseas purchases. The system has supplied 6.5 billion units monthly since June-- α-type is Green Cross' own (2 billion units monthly from leukocytes and 2.5 billion from lymphocytes), 1 billion units monthly of β-type are purchased from CRI and 1 billion units of γ-type are purchased from the U.S. Key Pharmaceutical Company. Many of the other companies which are fiercely competing in this development have put their energies into anticancer development from the beginning. In contrast, Green Cross' program is going from corneitis and conjunctivitis to herpes, hepatitis, influenza and then cancer. However, it is possible to broadly expand the treatment subjects because the extent to which supplies can be guaranteed has increased.

Indeed, the reason Green Cross' wrestling with IFN has become even more intense is because its dominance as the leader has started to become doubtful. This leading industry of more than 40 companies just in the major countries (there are 6-7 in Japan) is unfolding a development competition in disorder, and "our big dream is no longer possible." (President Hachiro Ishigaki) There are many unsettled aspects concerning the effect of IFN and production technology. This is a rapidly advancing, ultramodern field, and at least 10 years will be required for evaluation.

Optical Fibers: Rapid Domestic and Foreign Development with Establishment of a Coherent System--Sumitomo Electric Industries Ltd

At the end of March, Sumitomo Electric Industries formally decided on and adopted the "Optopia" symbol, and spelled out completely the decision to actively expand into the optical fiber field as the strategic division for the future.

"Optopia" is a compound word for optical fibers and utopia, meaning the ideal society through optical fibers and optoelectronics. President Masao Kamei is the godparent of optopia. As the top manufacturer of optical fibers, Sumitomo is changing the enterprise's image as far as its strategy is concerned. It has already expressed at home and abroad its posture of tackling optical fibers.

In this way, given the background of strategically nurturing and strengthening the optical fiber field, it cannot hold any great expectations for demands for electric wire, its main strength. On the other hand, it is forecast that the scale of the optical fiber market will expand rapidly in the future.

According to the forecast of the Nippon Densen Kogyo-Kai (Japan Association of Electric Wire Industries), electric wire shipments in 1985 will be 1.12 million tons (copper wire only), a 23-percent increase compared to 1980; and only 205,000 tons, a 10-percent increase over the 5 years, is forecast for the high-value-added electric power and communications cable.

In contrast, the optical fiber field has extremely broad applications, ranging from broadcasting and television, railroads and new transportation, and road traffic to aviation, disaster prevention, medical treatment, home appliances, OA machines, plants such as nuclear power, steel and petrochemicals, natural resources and marine development, in addition to private-line communication and electric power transmission. The scale of the market is expected to be more than 100 billion yen from the mid-1980's in Japan alone, and 500 billion yen worldwide.

On account of this, Sumitomo turned its attention to the field early on, and undertook research and development of optical fibers 10 years ago. In 1972 it developed on optical fiber resin coating technology; in 1979 it gave America's Corning Company license to implement production technology and manufacturing and marketing rights; in 1974 it developed the basic manufacturing process, the VAD method; in 1979 it succeeded in leading the world in the technological development of this VAD method in cooperation with Nippon Telegraph and Telephone Public Corporation. Furthermore, in April of this year, it developed high-quality optical fibers, developing an indium phosphorus-derived LED (light-emitting diode) as the light-emitting element and germanium-derived APD (apyrase photo diode or avalanche photo diode) as the light-receiving element. It is the first in Japan to be successful in the practical application of an optical communication system with long wavelengths.

Among these, the VAD method has received particular attention. In the past, the leading method was the MCVD (molecular chemical vapor disposition) method developed by America's Bell Laboratories and ITT, but by resolving the problem of mass production, which is a weakness of the MCVD method, the VAD method is highly rated as the technology which will replace the MCVD method from now on.

Sumitomo's strength is that in addition to the VAD method, it has the entire field of optical communication systems, ranging from optical fibers and optical fiber cables, light-emitting and light-receiving elements to optical branches (optical drops) and distributors, optical connectors and optical switches. It is superior in its engineering technology; and it has made its fiber communication system consistent and has established a comprehensive system for receiving orders.

Because of all this, Sumitomo first of all delivered 350 kilometers of optical fibers to the Ministry of International Trade and Industry's Higashi Ikoma Life Picture Information System, which received attention as the first project to use optical fibers in Japan in 1978. Then it almost monopolized the data highway for major steel companies; and it is steadily achieving results even overseas--America's Disneyland in 1978, in Brazil in 1979 and Argentina in 1980 (7,800 kilometers).

Sales connected to optical fibers were approximately 3 billion yen in 1980. This is still less than 1 percent of total sales, but at the end of this year, Nippon Telephone and Telegraph Public Corporation will start relay transmission by optical fiber cable in the 12 territories of the country; and in the United States there is a corridor plan connecting Boston, New York, Washington, Philadelphia by optical fibers, as well as a West Coast project; furthermore, a Pacific Ocean undersea cable is also planned. Because of all this, it has been forecast that sales this fiscal year will be 5-6 billion yen, 10 billion in 1982 and that it will accelerate even more after 1983.

Jet Engines: Orders Double; Challege to "Japan-UK Cooperative Development--Ishikawajima-Harima Heavy Industries Company Ltd

The prime contract competition for the Defense Agency's second-generation, medium-class trainer (MTX) is now in the final stage. Fuji Heavy Industries Ltd, Kawasaki Heavy Industries Ltd, and Mitsubishi Heavy Industries Ltd are fighting furiously for the decision on prime contractor for the fuselage to be made this fall. But the decision on the jet engine for the MTX was made ahead of the fuselage decision.

In contrast to competition for the fuselage decision--over which there has been a collision of domestic companies--America's Garrett, the "TFE 1041" of Sweden's Volvo and the "Lalzak" of France's Schneckma joined the fight for the MTX engine with an "unreasonably low-priced deal" (according to those involved). The competition was entangled in a three-cornered international fight which the "XF-3" of Ishikawajima-Harima (the Defense Agency's technology headquarters entrusted the development to Ishikawajima-Harima) fought to repulse; and it seems that the Defense Agency's comprehensive evaluation somehow decided in favor of Ishikawajima-Harima's "XF-3." So this will be a big business totalling 500 engines and 75 billion yen.

"I don't think we were chosen because we are a Japanese manufacturer. We were economical in total cost, including parts. The "XF-3" is superior in terms of fuel cost and light weight. If that weren't so, we could not have survived in the fierce

international jet engine competition." (Kenichiro Imai, managing director of Ishikawajima-Harima)

Ishikawajima-Harima spent 10 years bringing the "XF-3" to a successful conclusion. Moreover, during the first 6 years, it put its own money into this engine, a totally unknown quantity. The "XF-3" follows the "J-3," which was first completed in 1959, and is the second jet engine Japan has independently developed since the war. This victory in a rivalry with leading European and American manufacturers is a milepost indicating that Ishikawajima-Harima's jet engine has reached the international level.

"Indeed, the three top executives, Tsuchimitsu, Taguchi and Shindo were superb. We were not told even once to quit because there was no profit," said director Imai. The substantial history of Ishikawajima-Harima's jet engine started in 1959, when President Tsuchimitsu made the judgment to independently take on the J-3 engine developed by Japan Jet Engine (comprised of Ishikawajima-Harima, Mitsubishi, Fuji and Kawasaki). Making this purposeful decision while the other companies were seized with the fear that the jet engine would be exorbitantly expensive was counted as one of "Tsuchimitsu's three major reckless acts" for a long time.

Literally 20 years of unswerving loyalty. Ishikawajima-Harima makes its living by the licensed manufacture of jet engines for the Defense Agency's fighter aircraft. On the other hand, by endlessly accumulating development results, such as the VTOL (vertical takeoff and landing jet), list engine, and the Agency of Industrial Science and Technology project's FJR engine, Ishikawajima-Harima's accumulation of jet engine technology has steadily increased, and at present, its share of Japan's jet engine industry is about 60 percent. Kawasaki and Mitsubishi are far inferior, dividing the remaining share.

In 1978 it acquired the prime contract for the licensed manufacture of the F-100 engine for the leading second-generation jet fighter, the F-15; the T-56 jet engine for the subspotting plane, PC-3; and the numbers of planes ordered in 1980 topped the 100-billion-yen mark for the first time. Moreover, this is not just a one-time fluke. "Orders received from now on will increase sharply. Even if they double in comparison with the past 5 years, I don't think the figures are inconceivable." (Imai) In the Kure factory, the jet engine parts production line has been newly set up and the number of jet engine personnel has swelled to 3,600.

Ishikawajima-Harima is now wrestling with all its strength with the RJ-500 jet engine project, a Japan-UK joint development. UK's Rolls Royce and Japan bear a 50-50 responsibility for the development, and Ishikawajima-Harima is in charge of 60 percent of Japan's share. This is the first time for Ishikawajima-Harima, of course, and Japan to develop a private aircraft jet engine. Total development costs will be 140 billion yen.

In the beginning the RJ-500 started as a 20,000-pound-thrust engine for a 130-passenger aircraft, but has it now has shifted to a 25,000-pound-thrust engine for a 150-passenger aircraft, for which the largest market is anticipated. But in this class, there will be a head-on collision with the world's two jet engine giants, Pratt and Whitney and G.E. Because development costs are enormous, if not handled properly, it could be fatal. It may be said that whether Ishikawajima-Harima will remain in the position of "Japan's top manufacturer" or play an active role as an international jet engine manufacturer ranking with the two giants depends on this single battle.

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SCIENCE AND TECHNOLOGY

INDUSTRIAL SCIENCE AND TECHNOLOGY AGENCY PLANS UNIFIED COAL LIQUEFACTION PROJECT

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 21 Jul 81 p 3

[Unsigned article on government plans to pursue joint coal liquefaction project with Australia and to unify three domestic projects at the pilot plant stage.]

[Text] To further the work on coal liquefaction, the Sunshine Project headquarters in the Agency of Industrial Science and Technology has begun considering the idea of combining research on the three existing liquefaction projects, beginning with the construction stage of a pilot plant which is to start processing 250 tons of coal per day in fiscal 1984. Because of the failure of SRC-II, a joint project of Japan, the U.S. and West Germany which was the largest of the coal liquefaction projects financed by the government, the agency has wanted to establish new coal liquefaction technology to replace it. It has thus decided to go ahead with the Japanese-Australian lignite liquefaction project and at the same time to construct an independent pilot liquefaction plant which would bring together the three methods of the process development units now under construction, and so make use of technology accumulated on each method. In this way the agency hopes to bring about a commercial plant which excels at low-cost liquefaction.

Discontinuation of the SRC-II project has caused a considerable setback for Japan's coal liquefaction plans. Sunshine Project headquarters shares the view that coal liquefaction is a task which must be dealt with as one energy alternative to oil, and so it has agreed that the work of the Japan Lignite Liquefaction Co., which is planning a project to liquefy Australian Victorial lignite, should go ahead as scheduled. That is, beginning this fall a large (50 ton per day) pilot plant will be built and put into operation in Australia. Then a 5,000 ton plant is to be built beginning in the spring of 1983, and a 30,000 ton commercial plant is to be built at the end of the 1980s and the beginning of the 1980s.

The three projects on which experimentation has begun in Japan are the solvent processing method, the direct hydrogenation method and an improved solvolysis method.

Solvent processing liquefaction is being handled by 21 companies of the Sumitomo group, including Sumitomo Metal Industries, Sumitomo Coal Mining and Sumitomo Shoji Kaisha; they have begun experimentation at a one ton per day plant which has

been completed at the Hasaki Center of Sumitomo Metal Industries' central laboratories.

A 2.4 ton per day direct hydrogenation plant is being built (with a January 1982 target for completion) jointly by Nippon Kokan and Mitsui Shipbuilding and Engineering at Nippon Kokan's Ogishima steel mill. Asahai Chemical Industry Co is also participating in development of the catalyst.

A 0.1 ton improved solvolysis plant has been completed by Mitsubishi Heavy Industries and Mitsubishi Chemical Industries at Mitsubishi Heavy Industries' Hiroshima laboratories. If tests are successful, the one ton standard solvolysis plant located at Mitsubishi's Nagasaki shipyards will be converted to the improved method to increase the scale of experimentation.

Research on these three projects has been interim bench-scale and pilot-scale experimentation; operational research will be carried out for two years beginning in fiscal 1982, following completion of the plants. The policy under the original schedule was that pilot plants would continue research on the three projects, but because construction funds of from 100 to 200 billion yen are required for a facility to process 250 tons, it has been decided to reduce research costs by unifying the three projects at the pilot plant stage and use the technology of each to achieve a superior coal liquefaction plant.

The Agency of Industrial Science and Technology has decided that, "the technologies of all three projects are coming closer, and there is merit to the course of combining them." Following unification the agency would like to make further improvements in the technology, then build a demonstration plant of 3,000 to 5,000 tons per day and then a commercial plant of 30,000 tons, thus bringing about commercial coal liquefaction through independent Japanese technology.

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SCIENCE AND TECHNOLOGY

JAPAN NOW TO EMPHASIZE BROWN COAL LIQUEFACTION IN AUSTRALIA

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19 No 965, 28 Jul 81 p 5

/Text/

After the Solvent Refined Coal II project was abandoned by Japan, the U.S. and West Germany, the Ministry of International Trade & Industry has decided to chiefly promote the brown coal liquefaction between Japan and Australia.

MITI considers construction of a plant with daily coal input of 5,000 tons, following the completion in 1983 for a 50-ton daily plant. The large demonstration plant project is aimed at gaining scaling-up know-how — the kind of know-how MITI hoped Japanese companies can get by participating in the tripartite SRC-II project.

MITI's "Sunshine" project includes four coal liquefaction development plans. one is being developed by Japan and Australia's Victoria State. MITI's Sunshine officials judged, however, that it could not promote all four projects for cost reasons. Studies led to consideration that the Australian brown coal liquefaction deserves a top priority for several reasons.

Brown coal is easy to crack. The coal's commercial value is low because of spontaneous ignition — a point that MITI judged will prevent its price hike in future. Victoria was also judged to be easy to ship product fuel from. It has an estimated 30 billion tons of brown coal.

The Sunshine headquarters will try to obtain ¥40 billion to promote the Japanese-Australian brown coal development in fiscal 1981-1983. Specific planning includes moving up the 50-ton-a-day pilot plant's completion by several months (from the original target of July, 1983) and research in Japan for scaling up the reactor size. The tentative target data for the demonstration plant is 1986.

The alternative energy situation is marked by adverse factors, such as oversupplies of crude oil and SRC-II liquidation. But MITI's brown coal decision is based on the belief that a crude oil price hike is inevitable in medium- and long-term. Japan has every reason to develop coal liquefaction technology because of its heavy dependence on imported energy, MITI judged.

MITI was opposed to SRC-II abandonment until the last moment. Japanese participation, it thought, was a "must" to gain scaling up know-how from the 6,000-ton-a-day project.

CSO: 4120/319

SCIENCE AND TECHNOLOGY

STEEL FIRMS MOVING TO EXPAND PIPE PRODUCTION CAPACITY

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19 No 965, 28 Jul 81 p 5

/Text/

The four major steelmakers have begun to step up their seamless pipe production capacities as they expect the world's seamless steel pipe supply will continue tightening in next few years.

They are Nippon Steel Corp., Nippon Kokan K.K., Sumitomo Metal Industries, Ltd. and Kawasaki Steel Corp.

Their combined seamless pipe production capacities are expected to increase a little more than 60 per cent by 1983.

Nippon Steel has begun building a small diameter seamless pipe mill of the Mandrell rolling system at its Yawata works. This 400,000-ton yearly capacity mill will come on stream early in 1983.

Completion of this ¥80 billion mill will enable Nippon Steel to produce seamless steel pipe 33.4 to 406.4 mm in diameter.

Nippon Kokan will start building a seamless pipe mill at its Keihin works this fall at a total cost of ¥90 billion. Completion of this mill will boost the company's seamless pipe production capacity to 1.7 million tons a year.

Sumitomo Metal also plans to start building a 600,000-ton yearly capacity seamless pipe mill at its Kainan works in September. This mill will cost about ¥47 billion. Its annual seamless pipe capacity is expected to increase to 2.1 million tons in 1983.

Kawasaki Steel is expanding its Chita works' seamless pipe capacity from the present 504,000 tons a year to 828,000 tons by next March.

CSO: 4120/319

SCIENCE AND TECHNOLOGY

AUTOMAKERS BEGIN TO STRENGTHEN MARKETING NETWORKS IN AMERICA

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19 No 965, 28 Jul 81 p 6

/Text/

Major Japanese automakers are showing rising zeal in maintaining sales networks in the United States. They are trying to meet the industrywide moves to voluntarily curb exports to 1,680,000 units this fiscal year.

While trying to do without expansion of sales outlets, the industry is ready to put more muscle into marketing activities and give more benefits to their American dealerships.

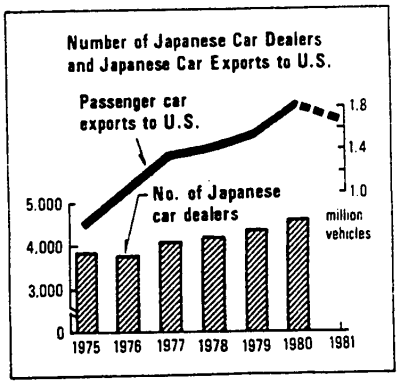
Japanese automakers, now unable to deliver an unlimited number of vehicles to their U.S. dealers, fear that the latter may find it unattractive to handle Japan-built cars because of a possible supply shortage.

Remedial measures now being worked out by Japanese automakers to prevent their American agents from leaving them are: 1) to increase the ratio of high grade, expensive cars to total vehicle exports; 2) to boost sales of pickup trucks which are outside the export restriction; and 3) to expand bounties for dealers.

On top of these steps, the automakers are employing a unique trade practice, unfamiliar to American businessmen, of sponsoring sightseeing tours for dealers and/or inviting them to banquets.

Also, Japanese automakers, as a step to increase profit margins for dealers by boosting the added value of their vehicles, are trying to get more orders in options such as lucrative air conditioners, power steering and audio equipment.

The number of U.S. dealerships handling Japanese vehicles has been steadily increasing these several years, reflecting the growing popularity of Japan-built subcompact cars.



Number of Japanese Automakers' Dealers in U.S.

Automaker	1976	1977	1978	1979	1980	1981
Toyota Motor Co.	975	1,014	1,050	1,049	1,062	1,085
Nissan Motor Co.	948	995	1,032	1,051	1,069	1,086
Honda Motor Co.	558	631	681	708	740	769
Toyo Kogyo Co.	630	520	597	701	759	764
Fuji Heavy Industries, Ltd.	743	661	732	713	738	750
Isuzu Motors, Ltd.	—	—	—	—	—	about 180

Note: Figures for Mitsubishi Motors Corp. and Isuzu in the 1976-1980 period are omitted because the dealers for their cars are affiliated with their respective American capital tie-up partners, Chrysler Corp. and General Motors Corp.

In early 1981, it climbed to 4,600 from the 3,800 in 1976. Notably, Toyota Motor Co. and Nissan Motor Co. have some 1,100 shops, respectively, and Honda Motor Co. has some 760 shops.

These dealerships ceased to increase with the emergence of the car trade friction between the two countries. With the decisive moves of the Japanese Government and industry to voluntarily curb exports in and after April, such a tendency has become even more conspicuous.

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SCIENCE AND TECHNOLOGY

POWER OF JAPANESE-BRITISH JET ENGINE IS LIKELY TO BE ENLARGED

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19 No 965, 28 Jul 81 p 6

/Text/

Three Japanese companies and Rolls-Royce Ltd. of Britain are likely to increase the capacity of the jet engines being developed in their joint project. The current program is based on the trio's agreement at the end of 1979.

According to sources close to the Japanese firms — Ishikawajima-Harima Heavy Industries Co. (IHI), Kawasaki Heavy Industries, Ltd., and Mitsubishi Heavy Industries, Ltd., the capacity of the proposed RJ500 series engines, last agreed on as 9.5-ton thrust types fit for 130-seat civilian transports, could be expanded to stronger 11.3-ton thrust types for 150-seaters.

Such a revision seems to have been discussed between the Japanese companies and Rolls-Royce when Taiji Ubukata, IHI president representing the trio, visited Britain late in July.

A follow-up meeting held during the same month at Bristol of the board of directors of Rolls-Royce and Japanese Aero Engines Ltd. of London, a joint Japanese-British RJ500 engine developing enterprise, may have decided on such engine capacity enlargement as proposed among the quartet in anticipation of greater international demand for such larger-capacity air engines.

But, according to the sources, enlarging the engine capacity poses some tough problems, such as swelling the original cost estimate of ¥140 billion, to possibly more than ¥200 billion; the inevitable need for increasing the Japanese Government's promised subsidy covering 50 per cent of the Japanese share of the development cost and difficulties in obtaining such an increase under the present administrative reform drive of Japanese Prime Minister Zenko Suzuki; and fierce rivalry in developing such larger engines being put up by other Western engine makers including the Pratt & Whitney Aircraft division of United Technologies Corp.

But the matter is delicate for the Suzuki Administration because Suzuki had promised to step up such Japanese-British industrial cooperation during his last European tour last June.

CSO: 4120/319

SCIENCE AND TECHNOLOGY

HONDA WILL MAKE CAR EMPLOYING 'NAVIGATION' SYSTEM LIKE PLANES

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19 No 965, 28 Jul 81 p 7

/Text/

Honda Motor Co. will start marketing in September a new type of passenger cars using 16-bit microprocessor.

Such microprocessors hitherto applied to passenger cars have been limited to 8 bits. They have been chiefly for automatic control of engine fuel injections and other engine controls.

The 16-bit microprocessor will not only take care of this but even regulate the manner of the car's navigation to ensure the right way as well as the safety of car movements.

Early in July, Toyota Motor Co. announced development of a similar Navigation Computer system. But this was an indicator, in 16 directions, of how correctly a car is going toward a destination according to basic information previously put in.

Honda Motor's new microcomputerized system is so promising that the company even envisions ultimate development of an automatic automobile driving system. The new cars to be marketed in September are also to automatically adjust their body balance according to the number of passengers and control their headlights.

Based on an applied version of the aircraft flight inertial guidance system, the new system constantly checks and finds out changes in the car's running inertial force, and thereby determines the car's present position on a given course of trip. Through a complex mathematical vector analysis of the car's movements, the system shows on a small display screen the locus (trace of motion) as worked out by such analysis. By overlapping the locus picture with a transparent road map showing the destination, the system keeps the driver well informed of how fast and which way to go in attaining the destination most effectively. If Honda Motor's bid proves a hit, 16-bit or more capable microprocessors could become the mainstay of automobile electronics.

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SCIENCE AND TECHNOLOGY

JAPAN-MADE PERSONAL COMPUTERS RUSH INTO AMERICAN MARKET

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19 No 965, 28 Jul 81 p 7

/Text/

Japanese personal computers have started moving into the American market with a rush, causing government officials to fear a possible rekindling of the Japan-U.S. friction over bilateral trade.

Among leading makers, Nippon Electric Co. (NEC), Sharp Corp., Canon, Inc. and Toshiba Corp. already have begun marketing their products in the U.S. Hitachi, Ltd. and Oki Electric Industry Co. are going to follow them soon.

Industrymen estimate that shipments of Japan-made personal computers to the U.S. will top 30,000 units, worth some ¥10 billion, this year, or the very first year of shipment. American makers thus are growingly concerned about the fast tempo of Japanese personal computers in penetrating into the U.S. market.

Sharp, an Osaka consumer electronics maker, was the first in exporting personal computers to the U.S. In March, the company started shipments of its PC3000 Series for marketing under its own brand. From this autumn, Sharp will market them under customers' brands on an original equipment manufacturer basis. At the same time, Sharp will introduce its MZ Series in the U.S. The company expects sales of its personal computers in fiscal 1981 will top 10,000 units.

NEC, the largest personal computer maker in Japan, started exporting the best-selling PC8001 model to the U.S. Already, shipments of 5,000 units have been completed. Upon formal approval by the U.S. Federal Communications Commission, NEC plans to undertake full-scale shipment to the U.S. from September. It has been consolidating marketing networks in the U.S. through NEC America, Inc., its wholly-owned subsidiary in New York City. NEC hopes to market around 15,000 units this year.

Canon also began shipments to Europe and the U.S. in March. Toshiba has just started marketing personal computers in the U.S. Toshiba opened in the middle of July a directly-operated personal computer store in Los Angeles. It hopes to open two similar stores by the end of this year. Toshiba hopes to market a total 3,000 units of personal computers and word processors this year.

Oki and Hitachi are now hurriedly making preparations for personal computer exports to the U.S.

With the rush of Japanese products, it seems certain that they will eventually hold a considerable market share. A U.S. Department of Commerce prediction has put the market share of Japan-made personal computers in the U.S. at 30-40 per cent in 1982.

According to an American market research firm, the U.S. personal computer market already has grown into a $2 billion-a-year business with yearly sales of about 500,000 units. More than 70 per cent of the market is now controlled by such venture businesses as Tandy Radio Shack, Apple Computer Inc. and Commodore Business Machines Corp. Texas Instruments Inc. and Hewlett-Packard Co. are steadily increasing sales, while Xerox Corp. has just entered the market and International Business Machines Corp. is about to do so.

CSO: 4120/319

SCIENCE AND TECHNOLOGY

PIPE SUCTION IS EYED FOR MANGANESE NODULE PICKUP

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19 No 965, 28 Jul 81 p 9

/Text/

A seven-year ¥22 billion project will be started shortly by the Government's Agency of Industrial Science and Technology to develop Japan's own method of effectively tapping abundant manganese nodules lying on deep ocean floors.

According to sources close to the Agency, belonging to the Ministry of International Trade and Industry, it has been decided that the project be launched this year to create such a good method by improving upon or otherwise modifying either of two internationally known experimental pneumatic suction methods of the kind.

The seven-year project will be divided into a first 4-year stage chiefly to develop machinery and equipment and a second 3-year stage to put such hardware to trial. Use of a 2,000-ton-class ore carrier converted into an experimental ship concerned during the second stage has also been decided.

There have already been various governmental or private projects, American, European and Japanese, to develop such ocean bottom resources, but none has so far been realized due to technological and other problems. Besides, realization of any such project will have to be timed with the conclusion of some international law-of-the-sea conference agreement on development of such open sea bottom resources, a common property of mankind.

As the sources reported, effective, especially commercially feasible, collection of such nodules, containing not only manganese, nickel, copper, cobalt, titanium and molybdenum, found scattered widely over ocean bottoms 3,000 to 6,000 meters deep, is still a big technological challenge to all nations eyeing the resources.

A continuous line-of-buckets method has so far been studied and tried in Japan, the U.S. and France. Such a method to lower a rotating steel wire-tied chain of many buckets to scoop up manganese nodules along with water and mud may be relatively simple and free from troubles like dredging. But the Japanese governmental agency has preferred to the two also Western-visualized pneumatic suction methods because the continuous bucket formula would be hardly effective enough to commercially pay off.

Though technically more complex, the two pneumatic methods, underwater pumping and airlift types, are considered far more promising. The pumping type will save much energy. But the pumping machinery to be fixed on some deep part of a pipeline will require a long power cable to send electric power to the machinery. The airlift type to blow air into the pipeline and bring up nodules by the ascending force of the returning air may be much more reliable, especially because it needs no underwater machinery. But it also has drawbacks, such as the need for much energy and difficulty of controlling a mixture of three kinds of simultaneously ascending substances — air, water, and manganese ores. Much technological wisdom will be required to work out the ultimate practicable method.

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SCIENCE AND TECHNOLOGY

HITACHI GROUP DEVELOPS POLARIZED LIGHT TRANSMITTING OPTICAL FIBER

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19 No 965, 29 Jul 81 p 8

/Text/

An innovational optical fiber that enables transmission of a straight polarized light has been jointly developed by Hitachi, Ltd. and Hitachi Cable, Ltd.

Light so far used in fiber optics communication technology passes through a fiber line, spreading right and left and up and down. Reflections from the line's inner walls push the light on its way. Such fiber optics communication is known as the MM (multiple-mode) type.

But it has been theoretically known that the transmittable volume of information by each flash of light through such lines could be increased to anywhere between 4 and 20 times by an SM (single-mode) type utilizing the polarized light in straight waves. The SM type of communication has been envisioned with the recently-developed very high quality optical fiber measuring only 10 microns or less in diameter. Nippon Telegraph and Telephone Public Corp. (NTT) is planning to inaugurate a new public telephone service using the MM type next year and the SM type by 1987 or 88.

But, in practice, it has been difficult to realize an SM type of fiber optics commmunication because even polarized light, when sent through such a fiber line, gives rise to derivative kinds of light spreading to and fro. At the receiving end, the polarized light can be recognized only by strength changes. Solution of the problem has been studied by many researchers.

The two Hitachi group firms have found their own answer to the problem by creating a matching polarization in the index (degree) of light refraction of the internal walls of the fiber. They have enclosed the light-transmitting center line of the fiber with a material greater in heat expansion in an elliptical form in cross-section and then wrapped up the first covering with another material of a lesser heat expansion rate in a round form in cross-section.

When the whole fiber of originally 2,000 degrees C. taken from the mold cools down and hardens at the room temperature, the resultant solidifying pressure has concentrated in the elliptical section to create the light refraction polarization. The new fiber is thus referred to as the "Elliptical Jacket Type Low Loss Polarized Wave Surface Preserving Light Fiber."

The new fiber has experimentally proved capable of carrying light signals for 10 kilometers or longer by the single mode, with only a maximum of 0.1 per cent of each round of flashes lost in the undesirable wavering of light.

More significantly, it has opened the way for wide applicability of fiber optics to many non-communication purposes, including a prospective superhigh precision optical fiber gyroscope for aircraft, ships, rockets, space ship, blood flowmeters and other medical apparatus, as well as inter-integrated circuitry connections in tomorrow's optical fiber communication sets.

CSO: 4120/319

SCIENCE AND TECHNOLOGY

SEVEN-YEAR PROJECT TO DEVELOP ROBOT FOR MAKING APPAREL

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19 No 966, 4 Aug 81 p 13

/Text/

Research on a tailoring robot system to supersede human tailors will be sponsored by the Japanese Ministry of International Trade & Industry. The prospective seven-year ¥15 billion project is to start in 1982, it was recently learned.

Sources close to MITI said the Ministry's proposed project, if successful, could result in the development of an almost completely unmanned tailoring system, possibly before other nations.

According to the sources, what MITI visualizes is an almost totally unmanned tailoring facility with robots designing, cutting, sewing, finishing and inspecting. That will naturally require new, extremely responsive types of robots with human-like senses of vision and touch as well as the most advanced kinds of electronic gadgets including a computer-aided designing device and a completely automated paper pattern making device. MITI will enlist the cooperation of all available domestic robot, computer and sewing machine makers and research institutions, whether governmental, academic or private. A coordinating technology research association will be set up.

Specific technological problems involved include the development of an automatic soft material handling system, an automatic three-dimensional processing system, as well as a system to produce a large variety of apparel. Each must be in small quantities, matching the modern trend of the Japanese apparel industry and changing times. From shirts, blouses and underwear, the proposed robot system will be able to make the most difficult dresses, jackets and other wear.

The sources said MITI has been prompted to plan such a project by the fact that the Japanese apparel industry faces the need to efficiently produce increasingly higher value added items due to competition from Southeast and other Asian nations and to cope with the growing shortage of manpower.

According to the sources, automated design, cutting and sewing have been attempted in various key Western countries as well. Sweden is believed to be among the most advanced in robotization. Last year, it started a five-year project, costing an equivalent of ¥20 billion, to develop an automatic system for sewing trousers, they said. But Japan could be as fast as any nation in such a drive in light of its well-known sophistication in electronic and optical technology, the sources added.

CSO: 4120/320

SCIENCE AND TECHNOLOGY

OMAN OIL PIPELINE PLAN WILL BE BACKED

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19 No 966, 4 Aug 81 pp 1, 15

/Text/

For further consolidating Japan's economic security, the Government has decided fully to back up a concept which had been proposed by Oman sometime ago for establishing a new 1,500-kilometer long oil pipeline running down the Arabian Peninsula from North to South.

This is because Saudi Arabia, which holds the key to realization of the project and earnestly wishes to achieve stable supply of its crude to Western nations, since then informally has sounded out Japan on the possibility of securing its cooperation in the plan through the large Japanese trading companies.

The Japanese Government is intending to work out a concrete cooperation plan by the time Saudi Arabian Crown Prince Fahd Ibn Abdul Aziz visits Japan this fall.

It is believed that the plan will take the form of a government-private industry national project, centering on the major general traders and big steelmakers.

As a beginning, the Government is expected to establish a machinery for propelling the project, tentatively referred to as "Gulf Pipeline Development Council."

Japan also is anticipated shortly to enter into negotiations with the U.S. on the aspect of ensuring the security of the pipeline after its completion.

At the present time, the Gulf countries, such as Kuwait, Saudi Arabia, Bahrain, Qatar and the United Arab Emirates, export over 15 million barrels of crude oil a day to the countries of the West. The entire amount has to be shipped through the narrow Strait of Hormuz, measuring only 70-80 kilometers wide, to get the oil out into the Arabian Sea and Indian Ocean.

The pipeline thus is planned as an alternative oil transport route in the event the Strait of Hormuz becomes unusable from closure owing to war or disputes, or due to congestion. Oman, which assumes the responsibility of ensuring safety of the straits, took the occasion of the Iran-Iraq War to raise its pipeline concept to Japan, the U.S. and European nations.

Sources close to the Japanese Government said that the principal points of informal sounding by Saudi Arabia were as follows:

—The starting point of the pipeline will be from the Ras Tannurah oil field in Saudi Arabia and its terminal, Masirah Island or Muscat.

—The Japanese will undertake laying down of the pipeline and its operation.

—Saudi Arabia will charge no fee for transport of oil through its territory.

—Owner of the pipeline will be Saudi Arabia.

—The price of the crude oil will be the same from point of piping to the terminal.

Meantime, informants said that one of the major points in carrying out the concept would be how to apportion the amount of governmental and private financial cooperation since the pipeline construction will cost about $4 billion.

CSO: 4120/320

SCIENCE AND TECHNOLOGY

THREE MORE THEMES WILL BE ADDED TO BIOMASS STUDY

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19 No 966, 4 Aug 81 p 13

/Text/

The Ministry of International Trade & Industry has decided to expand its biomass energy utilizing research and development project, underway since fiscal 1980 by adding three more study themes.

They are how effectively to gasify waste lumber; to grow and derive oil from some kinds of plant; to cultivate and obtain combustible gas from some species of seaweed.

Hitherto, MITI's biomass energy project had been limited to the production of fuel alcohol to substitute for or supplement the use of petroleum products.

The expansion of the project, starting in fiscal 1983 and ending in 1990, has come to be scheduled in view of the fact such promising sources of energy for regional supplies are still being ignored in Japan despite the need for developing every good new source of energy.

Developing of an effective way of gasifying waste lumber is envisioned as a potential economicl and reliable method of casseroling and turning into fuel gas the lumber or woodworking mill or city garbage wood chips, sawdust or wood shaving to generate energy for regional industrial centers.

Production of a hydrogen-carbon monoxide gas by casseroling waste wood had long been known and once tried in Japan during World War II, but all past attempts have proved inefficient and unreliable.

Such a waste wood resource utilizing idea has been found practical in Japan where it is impossible to directly use logs for gasification, such as studied or realized in Canada, Sweden or the U.S. In Japan, logs and lumber coming from its scarce forestry or imported are just too expensive.

Hydrocarbon (oil)-producing plants, like eucalyptus or the Tirucalli species of the genus euphorbia, of which American genetical engineers are now trying to develop highly oil-productive species by gene recombination, have so far been not actively grown in Japan due to high costs, including the price of farmland, and inefficiency. But in some hot remote regions, like Okinawa and southern islands, strong possibilities of developing such plant-based oil-producing industries have been recognized.

The seaweeds to be utilized for fuel gas production include the giant kelp or the Rijiri (island area) tangle in Japan's northern waters. Heat-cracked, such seaweeds generate much methane gas. In the U.S., the American Gas Association and other interests are already studying giant kelp gas production. Here, again, the Japanese have been going slow due to cost-efficiency considerations. Such energy, if well developed, could be applied at least regionally, even if transportation is costly.

CSO: 4120/320

SCIENCE AND TECHNOLOGY

BRIEFS

AMORPHOUS SILICON--Amorphous silicon is attracting interest as a raw material for solar batteries. The Electrotechnical Laboratory of the Agency of Industrial Science and Technology has recently developed a new method to prepare this high performance substance. It uses hydrogen and silan (silicon hydride) in 30:1 with a certain proportion of diborane (boron hydride), all heated to 300°C. In this mixture a high power of 80 watts is applied to electrodes 4cm apart for electric discharge. Features of the method are: (1) a large amount of hydrogen in the raw gas; (2) 16 times the discharge output compared with the previous 5 watts approximately; and, (3) 20 times the pressure of raw gas than before. The Dark current conductivity of the material which is one of the indicators which shows its suitability as a solar battery, has been improved about 1000 times in comparison to that of the existing method. Qualities remained unchanged even with increased boron addition, ensuring sound production of high performance amorphous silicon. To realize an amorphous silicon battery, it is essential to develop a manufacturing technique for high power amorphous silicon. For this reason the results achieved by the Laboratory constitute one breakthrough towards obtaining a highly efficient battery and will draw the attention of concerned parties. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 46/

METHANOL IN OIL BURNING POWER PRODUCTION--Both public and private sectors have decided to address themselves to research and development of a method that will extract methanol from coal or natural gas as a fuel substitute for oil burning thermal power plants. NEDO will spend ¥11.8 billion in a 5-year project starting in fiscal 1981 for a demonstrative burning test by 1985 F.Y. As a raw material of the chemical industry, methanol can be synthesized from almost every carbon compound such as coal and natural gas. This potential fuel for power generation features: (1) easy hauling and handling because of liquid state at room temperature; and, (2) clean exhaust owing to elimination of sulfur and nitrogen during its production. However, the caloric value per volume is half or less than that of oil and a million kW power station would require methanol of nearly 3 million kl annually. Although it is a hope for future fuel battery power generation, measures to counter the toxicity of aldehyde will be troublesome in the case of incomplete combustion. The Ministry of International Trade and Industry, along with NEDO, feels confident of practicalization through demonstration burning tests by fiscal 1985. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 46/

COM DEMONSTRATION TEST--The Electric Power Development Co. has commenced at the end of March an actual COM burning test in the Unit 1 of Takehara thermal power station. Earlier, as the final stage of COM technology development, a burning test facility with a full-scale boiler was completed and authorized in the administrative inspection. The company will conduct the test for a year in an attempt to prove continuous, stable burning in the actual unit for a prolonged period of time. The results of the experiment are eagerly awaited in order to extend coal utilization as an alternative energy to oil, including a possible reliability test of COM conversion for an oil burning boiler now in the stage of conceptual designing. The main unit for the test has a production capacity of 10 tons/hour, with a burning capacity of 8 tons/hour (two burners). /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 46/

COIL FOR REACTOR CONTROL RED DRIVE--Nippon Kokan K.K. has, as a world's first, succeeded in making practical a new rod control system, called an electromagnetic coil drive to provide for improved rod drive control, essential for safe operation of nuclear reactors. This system will be used in a new research reactor, the "High Neutron Flux Research Reactor," planned by Kyoto University. The company expects that the new system will greatly increase response during an emergency shutdown and will assist in further developments of large-scale systems for commercial use. In the electromagnetic coil drive, a plunger (a cylindrical iron core) on the axis of a control rod is regulated by moving a coil outside a steel tube; the system is simple and provides positive action. Known earlier in theory, it had not been actually tried since a pipe wall is needed between the electromagnet and the iron core thereby limiting high response. The firm has greatly improved response to providing 0.1-0.2mm accuracy by placing the electromagnet unit 4mm in advance of the iron core. One drawback of the system is costly (power consumption: 830W) because the rods must be held continuously, yet the company speculates that meantime there will be a considerable demand for the system for research reactors worldwide. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 48/

JOINT STUDY ON RADIOACTIVE WASTES--Japan and the U.S., in efforts to overcome the greatest obstacle to the promotion of nuclear power generation, have decided to research the problem of the disposal of radioactive wastes. The study aims chiefly to cope with treatment of high-level wastes discharged from reprocessing plants and low-level wastes from nuclear power stations, including radio-activated liquid sodium from fast breeder reactors. The U.S. Department of Energy (DOE) realized the need to promptly establish radwaste disposal technology to boost nuclear power production and has been asking Japan to conduct joint research. After discussions between both nations it was agreed to tackle the issue cooperatively, as one of the programs based on the "Japan-U.S. Agreement on FBR Cooperation" earlier signed by DOE and PNC (the Power Reactor and Nuclear Fuel Development Corporation). /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 48/

REACTOR DECOMMISSIONING STUDY INVITATION--The Swedish Government, through the Nuclear Energy Agency of the Organization for Economic Cooperation & Development (OECD-NEA), has requested Japan to participate in a decommissioning study of a reactor in Sweden, as an NEA joint project. This involves a closed reactor (12,000kW: PWR) for removal/dismantling under a three-year project. The cost

will be about ¥1 billion which will be funded by OECD countries. OECD-NEA office is now working on details and the idea is still under study by specialists in each nation. This country will also start positive consideration shortly. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 48/

DESIGNS FOR FBR FUEL REPROCESSING--The Power Reactor and Nuclear Fuel Development Corporation (PNC) is speeding up development of reprocessing technology for FBR spent nuclear fuels, in view of construction of the FBR prototype, the second stage of the development. PNC has already taken up conceptual designing for a reprocessing test facility and test production of major equipment, all planned for the FBR prototype "Monju." In addition, experiments will be performed on each process step in a soon to be completed research test facility. Detailed reprocessing procedures are also to be demonstrated shortly in a high-level waste laboratory in operation. Within fiscal 1981, spent fuels from the experimental FBR "Toyo," will be use for reprocessing experiments. PNC intends to establish, as soon as possible, reprocessing techniques for FBR fuels through those developments, in order to build a reprocessing test facility starting around 1985. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 48/

ENERGY-SAVING ANNEALING FURNACE--Osaka Gas Co. has developed an epoch-making microcomputer-controlled steel pipe annealing furnace of the energy and power-saving type. Conventionally, steel pipe annealing furnaces have been fired using A type heavy oil, and the original unit of fuel per ton of steel pipes used to be 377,000 kilocalories, but with this new energy-saving annealing furnace, the figure was reduced to 210,000 kilocalories, achieving a 44.3% reduction in energy consumption. Furthermore, the energy-saving efficiency is expected to be raised by another 10% or so, by programming the heat pattern using a microcomputer, in such a way that permits heat treatment of products by type. To be more precise, for energy-saving, the furnace is designed with particular consideration given to the following points. (1) A jet preheating device is installed by inducing exhaust gases of about 500°C that are discharged by the furnace to the front of the furnace (energy-saving rate, 19%), (2) by installing more suitable gas burners in the heating and soaking zones, and by improvement of the furnace structure itself, the furnace is designed so that the heat propagated is increased and the heat is distributed more evenly (6% energy-saving), (3) the weight of the furnace has been reduced by using ceramic fibers as heat insulation, reducing heat storage losses (15% energy-saving). /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 54/

SALES OF SEAWATER DESALINATION PLANTS--The greatest customers for seawater desalination plants are the Middle East countries with small rainfalls, and among them the country showing the most positive attitude toward seawater desalination is Saudi Arabia. From 1976 until 1979, the country has been placing orders with the advanced countries for big projects worth above ¥100 billion annually. But, with the start of 1980, the country's major projects had almost been completed, and inquiries for projects from neighbouring countries, Kuwait and Abu Dhabi, were also showing signs of tapering off in terms of scale, money and the number of inquiries. Consequently, the orders received in 1980 numbered only three. However, since the beginning of 1981, not only has Saudi Arabia but also other neighbouring countries such as Kuwait and Qatar have begun to show a positive

attitude toward plant construction. The inquiries Japan has received so far this year, including those for which negotiations have been going on since last year, number more than ten. How many of these inquiries Japan will be able to turn into firm contracts is unknown, but it is considered a certainty that the total projects received will be worth at least ¥300 billion. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 54/

SOLAR SEAWATER PLANT IN UAE--The Government of Japan has recently signed an official letter of contract providing for Japanese cooperation in the United Arab Emirates demonstration and test project for desalination of seawater by using solar heat. Under the contract, Japan is required to dispatch to UAE a technical survey mission to carry out detailed studies regarding the construction site and other matters. Full scale work is scheduled to start in April 1982 to draw up a plant design, and a demonstration plant with a daily capacity of 100 tons is to be constructed within two to three years. The project employs a new process. Under the process, desalination of seawater is achieved, first by creating high temperature water by using vacuum pipe type heat collectors developed by the Agency of Industrial Science and Technology under the "sunshine Program," and then by heating seawater by using the heat of the high temperature water until it evaporates. This is the first case in the world that a demonstration test of seawater desalination using solar heat has actually been planned. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 54/

STABLE HEAVY OIL-WATER EMULSION--Kansai Mercury has developed an MC type multi-layer emulsion device that can raise the combustion efficiency of boiler heavy oil by 10% to 20% while reducing NOx emissions by some 30% to 50%. In conventional emulsion fuels, the emulsion has not lasted very long because oil and water particles were uneven in size, but with this new device the oil and water particles become so minute as to become uniform in size, and thus the emulsion does not separate for at least several months, and in some emulsions this phenomenon does not occur for as long as a year. Therefore, the emulsion fuel-emulsified by adding water to oil--is released from the burner and burns. At this time, minute particles of water contained in the oil droplets vaporize instantaneously and collide with the surrounding fine particles of oil droplets. These oil particles induce a popcon phenomenon, causing themselves to further split into hundreds of minute particles. The optimum condition for combustion has thus been created. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 54/

QATAR SEAWATER DESALINATION--Kobe Steel has announced that as a means of cooperating with the seawater desalination enterprise, under a plan by the Government of Qatar as a national project, the firm has reqched an agreement with the Government of Qatar to start demonstration operation of a seawater desalination plant jointly with that country. The plan calls for Kobe Steel to manufacture a seawater desalination plant of the reverse osmosis type with a daily capacity of 100 tons, and to install it by the summer of this year, in the industrial zone facing the Arabian Gulf. Kobe Steel is required to operate the plant jointly with Qatar for two years after its completion. /Text/ /Toky TECHNOCRAT in English Vol 14, No 6 Jun 81 p 54/

HIGH-SPEED DUAL FUEL ENGINE--Niigata Engineering Co. has recently developed a small-sized dual fuel engine 6L16X-AG that is energy conservative yet is highly efficient. The greatest feature of this engine is that it can burn very efficiently, not only gas from sewage and industrial sludge but also a mixture of liquefied natural gas with heavy or light oil. Few dual fuel small-size and high-speed engines have bever been made. This is because the switchover to diesel-fired operation while responding to the variations in the amount of gas supplied and gas pressure have been difficult. In the development of the new engine, the firm's diesel engine development program made great efforts to solve these technical problems. As a result, the engine has succeeded in achieving a high energy efficiency, i.e. rated output of 375 horsepower at 1200rpm, a fuel consumption per hour per horsepower of 165g when the engine uses diesel oil, the total caloric consumption rate (in terms of heavy oil) of 168g when the engine uses gas. Helped by a supercharger, the engine has managed to obtain a thermal efficiency of about 37%--an efficiency about same as when it uses diesel oil. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 54/

MECHANICAL FEED UNITS--Nissan Motor Co. has developed DC-mechanical feed units for special purpose machine tools. As the new feed units are driven by thyristors of DC motors, the controlling parts are one-half the size of conventional feed units and can be made at 60% of the production cost of conventional units. The company has already equipped its transfer machines with 20 sets of the new feed units and has succeeded in raising their productivity by 20-30%. The hydraulic drive system has been mainly used for feed units because it is low-priced and is easy to operate. But this system has the following weak points: (1) the machining accuracy diminshes due to heat generated from the feed units; and (2) the machining cycle time changes with the viscocity change of the oil, caused by heat. On the other hand, some D.C. mechanical feed units directly coupled with a D.C. servomotor and ball screws, by using semiconductors, have been put to practical use recently, but they have drawbacks in that they are high-priced and take much space. Nissan Motor Co. has succeeded in developing economical D.C. mechanical feed units by adapting the low-priced, highly durable thyristor drive system in place of the semi-conductor power system, and by making each control part compact. The feed units are positioned by a stopper system, but the company plans to develop a free positioning system, a simple NC system and an AC mechanical feed device driven by an AC motor. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 56/

MACHINING CENTERS INCREASES--A total of 12,036 NC lathes were produced in Japan in 1980, an increase of 47% over the previous year. Production of machining centers increased by 79% to 5,231 units in 1980. Orders received for NC lathes and machining centers in 1980 totaled 118,400 million yen and 108,200 million yen, respectively, representing increases of 59% and 71% over the year before. NC lathe production, which reached a peak in 1980, has gradually decreased since the beginning of this year but it is expected that the demand for machining centers will continue. For example, beginning in April of this year, Hitachi Seiki Co. has cut monthly production of lathes from 100 units to 80 units, but has increased monthly output of machining centers from 50-60 units to 80 units. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 56/

AUTOMATIC PROFILING WELDING--The Tsu Research Office of Nippon Kokan K.K. Technical Research Institute has developed an automatic profiling welding system of non-contact type with arcs as sensors in a new method of narrow-gap welding. Under the automatic profiling system, a phenomenon in which the welding current increases when arcs approach the gap wall surface, beveling surface of the wall, and the special characteristics of unlimited constant voltage are utilized, and the center of oscillation is so controlled that it is positioned in the center of the beveling surface. The welding industry has recently started to use the MIG narrow gap welding method for welding thick plates of large structures, mainly pressure vessels. This welding method has merits in that the solvent cost drops, the welding performance is high and the welding process is greatly reduced. It, however, has drawbacks as operators have to work long hours continuously and the arc position changes because curved welding wires are used. However, by using the new automatic controlled welding equipment, these problems have been solved, and in test-welding plates 100mm thick and 400 meters long, it has been proven that the arc positioning is accurate and that, moreover, the welding performance is high. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 56/

PROFILING MACHINE EXPORT--Toshiba Machine Co., Ltd. has received an order for a profiling machine and an NC horizontal boring and miling machine from Boeing Co., an aircraft maker in the United States. The profiling machine is used for cutting, with very high accuracy, the intricately shaped fuselage and wings of aircraft which are made of materials such as titanium and aluminium alloys, typically difficult to cut. The profiling machine holds the key to controlling the performance of aircraft and is on the highest technical level among machine tools. Under the technical guidance of T.M.I. Co. of France, Toshiba Machine Co. has delivered two profiling machines to Japan Aircraft Co., three machines to Rockwell International Col of the U.S. and one machine to Hawker De Haviland Co. of Australia. The U.S. aircraft industry is flooded with inquiries about military aircraft from defense-related makers and there is a serious shortage of production equipment, mainly machine tools. In Japan, production of the Boeing 767, the next civilian transport plane, has begun on a full scale. Under these circumstances, Toshiba Machine Co. plans to actively develop the aircraft industry markets at home and abroad. /Text/ /Tokyo TECHNOCRAT in English Vol 16, No 6 Jun 81 p 56/

PROSPECTS FOR SPACE INDUSTRY--The Space Industry Basic Problem Discussion Group (a private advisory organ of the Director of the Machinery and Information Industries Bureau of the Ministry of International Trade and Industry) has recently summarized a report on long-term prospects for the space industry in Japan. The report points out the following: (1) The space industry in Japan in ten years will switch from the conventional "research and development" dependent type to a "practical" use type. (2) The market scale of the space industry in Japan, on the other hand, will grow from the current annual level of around ¥100 billion to an annual level of around ¥600 billion by 1990. (3) In order to support the above switch, the industry will aim at independence from foreign technology and establish independent technological foundations. At the same time, it will develop new space demands by promoting diversified utilization of space and planning to advance into foreign markets. (4) The government will be urged to relax restrictions in laws relating to space, such as the Wireless Telegraphy Law and the Public Telecommunications Law," in order to ensure staged "release" for the utilization of space. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 58/

PIPE-TYPE COAL TRANSPORT SYSTEM--Kayaba Industries Co. has developed a new pipe-type coal transport system. The system consists of a coal feed unit which pneumatically feeds solid, grainy or pulverized coal into the boiler, and an ash processing unit which discharges ash from combustion out of the plant. The system can transport pulverized coal and solid coal less than 7cm in size. Its feed speeds are 150-200m per minute. Because it uses pneumatic power for transport, the system permits a 3-dimensional structure, requires smaller floor space than is needed by mechanical transport systems such as conveyors, and nearly halves equipment costs. Since it is a low-speed transport system, the level of static charge due to friction is reduced to 1/100 of that in the case of high-speed powder transport. Moreover, the hazard of coal dust explosion and the scattering or breakage of goods being transported are prevented. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 58/

GASOHOL CAR NEARS PRACTICAL USE STAGE--Toyota Motor Co. Ltd. has supplied a gasohol car to the University of Santa Clara in the U.S. This gasohol car permits the use of either ethyl alcohol or methyl alcohol and a relatively high mixing ratio of 10-20%. Recognizing that gasohol cars with the mixing ratio of 10-20% have reached the stage of practical use, the company intends to establish a supply system for gasohol cars in accordance with future market trends. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 58/

MARINE COLOR RADAR--Koden Seisakusho, a marine equipment maker, has announced that it has developed a marine color radar "MDC 406," has required its certification from the Federal Communications Committee of the U.S., and has received an order for 300 units from its affiliate S1 (Scitex) in the U.S. The color radar is a two-unit type consisting of an antenna unit and an indication unit. It displays echoes in four colors--red, yellow, green and blue--in order of their intensity. Also, it enables the observer to see three-dimensional color images without a hood and is provided with a simplified alarm system which, upon the display of an echo from any ship in a doughnut zone one and two mile range, sounds an alarm, processes its signal and the image blinks. The course of any ship detected is indicated by black dots and the path to the target by a white arc line on the screen, while distances and angles measured are indicated digitally by the use of light emitting diodes. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 58/

FROZEN SEA SHIP TEST TANK--A "frozen sea ship test tank" has been completed by the Ministry of Transport's Institute of Technical Research for Ships. It is a water tank 35m long, 6m wide and 1.8m deep and is equipped with a cooler on the ceiling to freeze the surface of the tank water. It can simulate a frozen sea with an ice thickness of around 2-2.5m. For the time being, the tank will be used by the Institute to estimate horsepower requirements for actual ships and for ship types which require less horsepower and to measure strengths of parts of ships. The Institute ultimately aims to collect data for construction of a 100,000-300,000t class LNG vessel which can move through seas with an ice thickness of 2m and with a practical speed of 3-5 knots in a frozen area. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 58/

CERAMIC AUTOMOBILE ENGINE--Kyoto Ceramics will undertake full-scale development of automobile diesel engines made of fine ceramics produced by baking a highly pure inorganic substance as part of 4-year plan beginning in 1981. The company is planning, in cooperation with an automobile manufacturer, to convert the material of cylinder blocks into ceramics and make major parts out of non-oxide ceramics, mainly composed of silicon nitride. The company will begin with single-cylinder engines and will ultimately develop 2000cc 4-cylinder diesel engines. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 58/

AUTOMATIC SHIP NAVIGATION SYSTEM--With the collaboration of Yamashita-Shinnihon Steamship Co. and Hokushin Electric Works, Ltd., Hitachi Shipbuilding and Engineering Co., Ltd. has developed "Transoline Mk-II," an automatic ship navigation system and has started a campaign to sell the system. The system is an epochal invention in that it collects innumerable data in all weather and in all sea areas, processes it with high accuracy and navigates the ship automatically while finding out an optimal course. The system has the following features: (1) It has navigating calculations, navigation plans, log records, etc., all incorporated in automatic computer processing to facilitate human work. (2) It is capable of statistical processing data from ship location sensors such as NNSS, loran C, omega and decca and offering high-accuracy data on ship locations in all weather and in all sea areas. (3) It applies automatic computer navigation and autotracking, permitting navigation with higher accuracy than conventionally achieved by mates and autopilots while making a great contribution to saving labor and energy. A ship equipped with this system will annually save 4-5% (or about ¥40-50 million in terms of fuel oil cost) of fuel costs required by a ship ordinarily equipped. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 59/

HIGH SPEED BIPOLAR VLSI LOGIC--Mitsubishi Electric Co. has developed a high speed bipolar VLSI logic circuit of master slice type. Applying the technique of microbeam processing of 2.5um, this master slice has 21,952 elements, which is considered to be the maximum capacity of a bipolar IC. Thus the high integration of 2,500 gates has been accomplished. An average delay time of 0.83ns/gate has been obtained at a power consumption of 0.5mW/gate, and the resultant product of delay time with power was 0.44pJ. This master slice has been applied to the 9 bits memory data resistor circuit of 1,983 gates and has been installed in the 224 pin (plug-in type) package. The power consumption was 1.74 watts, which can satisfactorily be handled with current heat dissipation techniques. The new techniques used in developing the master slice are as follows: (1) By inventing a new process for separating the oxide layer, the walled-emittor structure has been realized, and thus the elements have been miniaturised and stray capacity has been reduced. (2) By commonly using the input transistor for neighbouring prime gates, a layout design has become possible to help improve the working efficiency of input transistors. (3) Lower power consumption has been possible by the circuit design of low voltage, such as the low logical amplitude or new buffer circuit. (4) A multi-pin technique (which is called an inner lead package with a two-step structure) has been adopted. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 60/

MASK MATERIAL FOR SEMICONDUCTORS--Hoya Electronics has commercialized three kinds of high performance mask materials (Mask Blanks) for semiconductors to be used for VLSI. These products are "AR-III" of low reflection, "AS-II" of antielectrostatics, and "CRST" of chrome see-through type. Regarding the low reflection type, the most popular one is the double layer structure which consists of a chrome layer and chromium-oxide layer formed on a low reflection glass plate. Until now, the two layers have been independently formed, but in the case of the "AR-III" the use of the reactive sputtering method has made continuous production possible. Thus, it is definitely possible to perform stable mass-production--which is over five times more efficient than the current method. Further, the etching time, film pressure, and reflection index, have been reduced to one-half, and ease of operation is another benefit. As for the antielectrostatics type, the present one has a demerit of weak resistance to sulfuric acid type chemicals (especially at high temperatures) that are widely used for washing masks and exfoliating resists. These demerits, however, are reduced in the case of "AS-II." The chrome see-through type, which is quite different from the ferrous oxide see-through type in the etching process, has been developed to overcome the problems (such as the variation of the treating time, pinholes, and resistance to chemicals, and is suitable for the reflecting projection type exposure apparatus. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 60/

SEMICONDUCTOR LASER PRODUCTION--Matsushita Electronic Industry has decided to begin mass-production of a TS type semiconductor laser, "MEL 4745," which is an oscillator of low current and large output. This corresponds to the situation in which the planning of the production of the digital-audio-disk player (DAD player) by an optical system has been achieved. GaAlAs laser (wave length 810nm), which is to be mass-produced by the company, is different from the current semiconductor laser in respect to the following points. A step is formed on a GaAs baseplate by chemical etching and each layer is grown epitaxially on it. Thus, at each step of active layer, light is closed horizontally, and a laser beam with a circular cross-section is obtained. Also, by adopting the TS structure, the threshold current is reduced to 30mA, or only a few tenths of the old type, and further, a large output of 5mW is obtained. Because of the low threshold current it has a long life of several tens of thousands of hours. And, furthermore, spot oscillation with a single transversal mode in a stable state can reduce noise. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 60/

HIGH SPEED SHOTTKY TYPE PROM--Fujitsu has begun to sell the "MB7141" and "MB7142," both of which are the 32K bit (4096x8 bits) high speed Shottky type PROM. These PROMS are of a junction-short type which consists of a memory cell along the depth direction of the chip because the aluminum electrode alloyed eutectically with silicon is grown thermally and information is written into the PN junction. Moreover, a reduction of the memory cell to $0.39mm^2$ has been accomplished by extending the application technique of V-slot isolation that reduces the mutual interference of the memory cells. Main specification is as follows: Access time: Maximum 65ns and 80ns, standard 45ns; Input/output level: Maximum 970mW, standard 700mW; Power supply voltage: +5V single; Chip area: $5.8x4.6mm^2$; Size of memory: $14x18um^2$; Package: Standard 24 pins. The price is ¥19,000/piece for a large number, i.e. 100 to 1,000 pieces. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 60/

256K BIT CMOS MASK ROM--Hitachi has developed a 256K bit CMOS mask ROM, "HN61256." This is a product manufactured by the 3μm silicon gate CMOS process to satisfy the increasing demand for the large capacity mask ROM which is in line with the growing application of microprocessors. Two kinds of memory constitution, that is, 32768 wordsx8 bits and 65536 wordsx4 bits, are announced. Its low power consumption (such as 0.5mA at working state and 1μA at standby) is suitable for a battery operated system. The main features are as follows: (1) Access time 6μs, cycle time 7.5μs, comparatively low speed. (2) A 28-pin dual-inline package and a standard pin arrangement are adopted, resulting in easy interchange with others. (3) Both input and output are TTL levels and output is three state. As such the design and expansion of the system are facilitated. Power supply voltage is 5V single. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 60/

HIGH SPEED CMOS-ROM PRODUCTION--Sharp Corp. has succeeded in the mass production of a 32K bit high speed CMOS-ROM "LH5332" having an access time of 450ns. The power consumption of the "LH5332" is about 15mA in the working state and less than 1μA at standby, based on a supply voltage of 5V. The package is a 24 pin dual-inline type. Though Sharp has not announced the actual method of obtaining the high speed in this device, it is supposed to be possible to reduce the access time to 250ns by the same process. The company will also soon manufacture a 64K bit CMOS mask ROM with an access time of 450ns. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 60/

OPTICAL FIBER SUBMARINE POWER CABLE--Fujikura Densen Co. has announced that it has delivered a compound submarine power cable of optical fiber worth $200,000 total to ABK Co. of the United Arab Emirates. The cable comprises three polyethylene insulating cores for 6,600V power supply, eight pairs of control wire cores and six optical communication fibers. It is also 85mm in diameter and 2,600m in total length. The built-in optical fiber is graded with 50μ in core diameter and 125μ in outer diameter. The six fibers combined are said to equal over 10,000 telephone circuits. The cable will be used to link an oil well platform with an oil collecting base for submarine oil fields. This is the first time that this type of optical fiber has been exported from Japan and used in a foreign country. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 62/

LONG LIFE BATTERIES--NTT has started development of a long life battery to cope with pending commercial optical communications. NTT has also started construction to install optical fibers between telephone stations in Tokyo and Osaka with the service commencement expected at the end of 1981. But NTT is planning to use optical fibers not only between telephone stations but also between these stations and subscribers around 1990. In optical communication, glass fibers in a bundle transfer sound and image information optically rather than electrically. However, this type of communication has one defect. Unlike copper cables used in conventional electrical communications, the optical fiber cannot convey electricity. Therefore, when it is used for telephones, another method is necessary to ring the telephone set. NTT will solve this problem by developing an improved litium battery which will have an electric charge and power twice as strong as conventional batteries. If the development succeeds, the technology will be widely applied not only to optical communications but mobile telephone systems as well. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 62/

SECOND METEOROLOGICAL SATELLITE LAUNCH--GMS-2, the second stationary meteorological satellite will be launched at the Tanegashima Space Center in August 1981. It will replace the presently used satellite "Himawari" which was launched in 1977 and now reaching the limit of its durability. The new satellite will be lightened and improved in operation by the built-in posture control equipment. The ratio of materials domestically manufactured will be raised from 11% to 35%. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 62/

OPTICAL FIBER EARTH WIRE--Tokyo Electric Co. has announced that it has developed a new communication method which uses an optical fiber built into the overhead earth wire of transmission power lines. Conventionally, the microwave wireless communication methods have been used for communications in the super high voltage power systems. However, because this method has been used in urban areas recently some problems (such as poor propagation of radio waves and limited power transmission capacity) have been experienced. Under these circumstances, Tokyo Electric Co., which started studying on an optical fiber compound overhead earth wire in collaboration with Hitachi Densen Co. and Sumitomo Denko Co., has succeeded in the development. A new fiber has, in its core, an optical fiber built-in unit which is covered by aluminum wrapped steel wires. Therefore, it functions as an overhead ground wire and communication line. The company states that it plans to implement the new wire in a few years, after extensive tests. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 62/

NEW TYPE DUCT BENDING TOOL--Presently, a telephone cable uses metal ducts with 75mm diameter and 50mm diameter. Complicated bending has been recently required construction in large cities. The installment of telephone cables is allowed only for those within limited curvature radius. Conventionally, ducts are bent on the ground in advance and then conveyed under the ground to be installed with its passing performance being checked. Consequently, construction has been rather inneficient. Under these circumstances, NTT and Matsuda Mfg. have jointly succeeded in developing a new compact type duct bender to be used for more efficient construction of telephone cables. A new duct bender is light and compact with largely increased bending accuracy. Moreover, it can omit checking of passing performance in actual installation. Other features are that it is made of aluminum alloy weighing 19kg and that the ducts of both 75mm diameter and 50mm diameter can be used together. It will be widely used for those construction sites with a lot of underground ducts such as in large cities. /Text/ /Tokyo TECHNOCRAT in English Vol 16, No 6 Jun 81 p 62/

CAPTAIN SECOND TERM TEST--The Ministry of Posts and Telecommunications has disclosed an outline of the second term test of the CAPTAIN system aiming at the commercialization of the system in F.Y. 1983. The test service will be offered to 2,000 monitors in 1981 and 1982. The features of the scheduled test are as follows: (1) Many business firms will be designated as monitors; and, (2) Two new services will be provided; one is a closed user group service which allows only selected terminal groups to use specific information and the other, an order entry service, permits users to input information for their specific demands to be sent to information providers. The user terminal function for the system has been also added and improved: (1) The storage capacity of information has been expanded from 100,000 to 200,000 frames; (2) The frame making speed has

been increased to 5 seconds per frame; and, (3) the input function has been improved by using a Kana/Kanji conversion type input terminal and a camera type input terminal. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 62/

DATA COMMUNICATION TEST--The public data communication network is linked with computers and terminals from a variety of manufacturers whose protocols are different from each other, not permitting international communications. KDD has developed a conversion device which permits communication between machines with different protocols. Using the device, it has already succeeded in a test for international data communication between computers and terminals, and between terminals in the U.S. and France. Overseas communications firms are reported to be engaged in standardization of various protocols following recommendations from CCITT. Timenet and telenet of the U.S. public data communication network, and Transpack of France, have developed a protocol conversion device similar to KDD's. By the means of this device, international data communications via data communication networks of each country is possible. Also in England and Canada, some attempts have been made to complete international data communication network by standardizing protocols. Under these circumstances, KDD has started negotiations with international communications firms so that it will add England and Canada as partners of the test to expand the present bilateral test to a multilateral one. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 62/

COMPUTER FOR SCIENTIFIC CALCULATIONS--Toshiba has placed on sale "TOSBAC Data System 600," a computer for exclusive use in scientific and technological calculations. This computer uses the 32-bit high-speed processor, with a processing rate of 1.2 MIPs (1MIPs means rate of executing one million instructions per second), so that complicated calculations and simulations for technological designing can be made. Moreover, it is provided with the following features to provide designs fitted to scientific and technological calculations: (1) It is provided with direct memory access (DMA) functions to shorten the time for inputting and outputting data. (2) It has a floating-point arithmetic operation mechanism. (3) It can also handle analog information. The central processor executes addition and subtractions on floating point data in 0.60 microsecond, with up to 2 megabyte of the main memory capacity. It is priced at ¥20,850,000 for the basic configuration. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 64/

HUMAN DEMAND COMPUTER--The Japan Information Processing Development Association has recently compiled a report regarding the target image and research and development subjects of the computer which will be put to practical use in the 1990's. The report mentions the following functions which the fifth generation computer should have. (1) It can understand the meaning of questions and specifications of what a man is asking of the computer. (2) It can automatically compose procedures or ways of processing information such as of programs. (3) The combination of the processing procedure and the hardware will be optimal. (4) It can automatically compose response (e.g., of speech synthesis) to a human being by output from the mechanical system. Whereas the present computer can accumulate data, they are just rows of numbers or characters which in themselves do not have any meaning and cannot be called knowledge. In contrast to this, the fifth generation computer should handle knowledge (the collection of which is called the knowledge base in this report). /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 64/

SUPERSIZED COMPUTER--Nippon Telegraph and Telephone Public Corporation has announced that it has successfully developed the supersized "DLPS11 Model 45," the largest and highest speed computer in the world. "Model 45" is the largest one of the "DIPS-1 Series" four types of which, ranging from small to large sizes, are being used by NTT as computers for data communication. It has a main memory capacity of 128 megabytes as compared with 16 megabytes for the "Model 35," which has been the largest model so far, and has two kinds of buffer memory capacity--a high-speed one (64-K bytes) and a medium-speed one (512-K bytes). Moreover, as the delay time per gate is only 0.35 nanoseconds, the processing speed is the highest in the world, surpassing the 0.45 nanosecond delay time per gate of large-sized computers which IBM of the U.S. and Hitachi Ltd. are aiming to put to practical use. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 64/

JAPANESE LANGUAGE COM SYSTEM--Yamaaaki Metal Industry Co. has succeeded in developing a Japanese language COM system called "YG-SYSTEM 8100." This sytem is an intelligent COM which consists of a Japanese language processing device, a magnetic tape, a floppy disk unit, a display unit, and a computer. As the pattern of the heart, a recognition system developed by the company has been adopted and its recognition rate is claimed to be 100%. It can recognize up to 14,000 Chinese characters, and has a memory capacity of 256-K bytes. Using the system as a sales weapon, the company plans to get increased orders for COM. Depending on the needs of COM users, the company will study the matter of commercializing the system. COM will thus enter the Japanese language information processing age. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 64/

OPTICAL FIBER TEMPERATURE MEASURING--Mitsubishi Electric Co. has succeeded in developing a remote temperature measuring device using an optical fiber. This device utilizes the changes of semi-conductor light absorption associated with temperature changes and transmits light onto the temperature sensor (a semi-conductor) through an optical fiber from a remote location and then retransmits the reflected light back to the measuring instrument by an optical fiber, detecting temperature by the strength or weakness of the reflected light signal. The temperature sensor is 1.8mm in diameter and 3cm in length. A 0.1 to 0.5mm semi-conductor piece is sandwiched in it by an optical fiber. A semi-conductor used as the sensor differs depending upon the range of temperature to be measured. GaAs is used for low temperatures up to 200°C, and CaTe for 400 to 500°C. As for the light source, LEDs are used for a wider range of less accurate temperature measurement, and a semi-conductor laser for a narrower range of highly accurate measurement. This measuring instrument has the feature of zero electrical noise, and Mitsubishi says that it will be very powerful for abnormality diagnosis or optimum control of the operation state if it is applied to temperature measurement of various plant devices. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 66/

SODIUM LIQUID LEVEL GUAGE--The sodium liquid level guage by Sukekawa Electric Industry Co. has been given a high evaluation by Power Authorities in France (EDF). A sodium liquid level guage is used to measure the level of liquid metal sodium that is used as a coolant of a nuclear fast breeder reactor. The level gauge that was exported by the company to EDF is an inductive and continuous model. When a high frequency current flows through either of a pair of coils set

in sodium, the induction voltage created in the opposite coil changes according to the level of liquid sodium. The gauge measures the liquid level by utilizing the above phenomenon. Generally, as the induction voltage is influenced by changes of sodium temperature, the temperature influence is calculated and corrected. However, the structure of the new level gauge has another pair of coils that are influenced only by temperature changes and it utilizes the difference between the two pairs of coils to obtain a signal proportional to the liquid level. EDF reports that: (1) temperature compensation is available; (2) operation is stable; and (3) the error is within 1.5%. EDF gives a high evaluation of performance to the gauge. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 66/

POLYACETYLENE POSSIBLE CONDUCTIVE MATERIAL--The development of conductive high-molecular materials can be mentioned as one of the themes for future technological development, and from this point of view, polyacetylene is receiving much attention. Polyacetylene has for long been well known but its technological progress has been rather slow because this material is hard to form freely or make into films. Now, it is attracting attention as an engineering university has developed technology to use it for making films. In the U.S. it is reported that polyacetylene can be used as a substitute for lead in lead storage batteries. Under these circumstances, plastic makers are taking a positive attitude toward conductive materials, and research for putting polyacetylene to practical use in the future is being conducted. Conductive materials are attracting fresh attention because, by putting them to practical use, they can replace copper and aluminum wires and cables, and thus achieve a drastic saving of natural resources and energy, in the form of increased power transmission efficiency, etc. They also can have advantages in such applications as in linear motors and MHD power generation, saving of rare metals such as platinum as high-performance electrodes, and in the rationalization of production when used as easy-to-machine electrical materials. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 70/

NEW PLASTIC SCINTILLATOR--With the progress in researches in the field of high-energy physics, there is increasing demand for plastic scintillators as detectors of radiation. Now, Kyowa Gas Chemical Co. has developed a high-performance, low-cost plastic scintillator which is quite different from conventional types, foreign or domestic. The new scintillator is made of a copolymer resin composed of acryl and styrene. It has an increased light-emitting factor of 35-38%, a comparable level with that of British products. In general, acryl resin has such features as high transparency and ease of rolling, machining, forming and grinding. However, because it has no fluorescence, the resin has lacked in wide appeal. Thus, conventionally, expensive fluorescent materials have been included together with 10-15% ultrapure naphthalene in acryl. This method, however, had the drawback of decreasing transparency with increased inclusion of naphthalene. The scintillator newly developed, has been made successful by using a copolymer of acryl and styrene. /Text/ /Tokyo TECHNOCRAT in English Vol 14, No 6 Jun 81 p 70/

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