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Komatsu, as part of its involvement in the field of electronics, is constantly accumulating and refining proprietary technologies relating to computers, communications and software. At the same time we are working to develop products that can reduce energy consumption and, preserve resources.

Overview of Komatsu's Electronics Operation

Our involvement in electronics began in the mid-1970s, when the company started to employ computerized control for use in its industrial machinery. Since then we have continually pursued the use of electronic control for large machines, an example of which is the 1981 release of the world's first electronically controlled construction equipment featuring built-in microcomputers.

These technologies have been the driving force for Komatsu to diversify its business areas. For example, our effort to save energy and resources extends to the excimer-laser light sources that play a critical role in the exposure process of semiconductor production, and to the network devices used in offices and homes.

Saving Energy and Resources Through Electronic Control of Construction Equipment

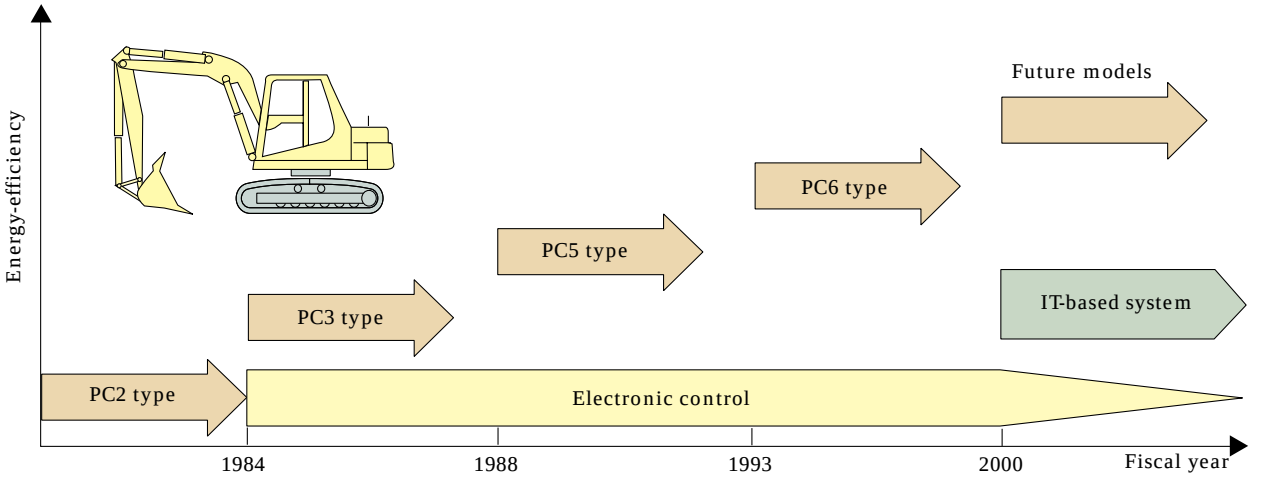
Construction equipment is mostly powered by diesel engines. It is our mission at Komatsu to develop fuel-efficient, low-emission, diesel engines. We have adopted an electronic fuel-injection control system and greatly improved the response time from the traditional several milliseconds (thousandths of a second) to several microseconds (millionths of a second), thereby achieving more precise control of injection timing and duration. When the engine starts, the battery voltage drops due to the starter motor's transient weight loading. Moreover, we modified the electronic circuit in order to ensure that fuel-injection commands are issued in a consistent manner regardless of operating conditions. This has made it possible to further reduce the amount of pollutants emitted during equipment startup.

Energy-efficient Hydraulic Excavators

The energy-saving technology employed in our hydraulic excavators is also based on electronic control using microcomputers. Komatsu is therefore positioning this energy-saving technology for hydraulic excavators as a critical technology, since machines of this type account for more than half the total production and shipment of our construction equipment.

Komatsu's 1984 introduction of the world's first electronically controlled hydraulic excavators had considerable influence on the progress of "mechatronics" in construction equipment. Since then, we have continuously improved our electronic control systems, achieving greater energy-efficiency by employing the cutting-edge systems of the

Improvement of Energy-efficiency with Hydraulic Excavators



Control method	Total hydraulic pressure	Electronic OLSS	Pump/engine complex control	Electronic CLSS	Systemized
Effect	–	The unwarranted loss of horsepower under light loads can be reduced by switching among various operating modes.	Optimal engine operation can be maintained under any load condition.	The loss of hydraulic pressure can be significantly reduced during the performance of complex actions.	Overall work efficiency can be increased and work conditions optimized by taking into consideration the work method and team of construction equipment used.

OLSS: Open Center Load Sensing System

CLSS: Closed Center Load Sensing System

times. The figure illustrates the various technologies we've introduced over the years. Without doubt, our quest for technological innovation has motivated a process of evolution, not only in energy-saving technology but also in other technologies relating to emissions, quietness, overall functionality and operator comfort.

Komatsu believes the development of an efficient, optimally integrated system is the key to more efficient on-site operation of construction equipment. To that end we are tackling the following issues by making use of the rapidly advancing IT (information technology).

1. Development of a method guidance system that assists the operator, including those with relatively little experience, by providing reference information on work-execution methods in order to minimize unnecessary steps.
2. Application of group controls, whereby multiple pieces of construction equipment can be strategically positioned and operated in a coordinated manner so as to optimize work efficiency.

Energy Efficiency in the Manufacture of Excimer Lasers for Semiconductor Exposure

Steppers or scanners are used at semiconductor IC factories for the purpose of printing electronic circuits onto wafers. In this process the excimer laser, with its shorter wavelength, is used as a source of deep-ultraviolet light. The two types of excimer lasers available include KrF excimer lasers (wavelength: 248 nm) using krypton gas, and next-generation ArF excimer lasers (wavelength: 193 nm) using argon gas. However, these excimer lasers require high power input relative to the optical energy needed for exposure. Therefore, the reduction of power consumption by numerous excimer lasers operating in the exposure process at a semiconductor factory will lead to a significant reduction in the factory's overall environmental impact. At Komatsu we are working to reduce the power required by light-source devices and the consumption of laser gas, having identified them as the two key targets of environmental activity in this field.

We have made quite an achievement with respect to the power source used for plasma generation and the efficiency of the discharge part. For example, the discharge efficiency of the 2-kHz model released in 1999 is 2.19 times the level of the KrF laser, a 1997 model with a repetition frequency of 1 kHz. Currently we are developing a new 4-kHz model for use in state-of-the-art LSI factories, endeavoring to increase its efficiency to a factor of 2.6 times. With regard to the input power needed to obtain the specified optical energy, the 2 kHz model requires only 26 percent of the power needed in its 1 kHz counterpart. The new 4-kHz model aims to reduce the power requirement a further 30 percent.

Energy-efficient Network Devices

In today's Internet age, the use of printers and print servers is growing at a rapid pace. Commensurately, the total power consumed by the growing numbers of printers and print servers is increasing constantly. To address the environmental concerns associated with this trend, the printer industry has been developing energy-efficient printers and promoting the recycling of consumables. As one of the component devices comprising a network, the print server must incorporate effective measures on behalf of power-efficiency and reduced resource consumption.

Komatsu has spent a year-and-a-half developing a dedicated print-server ASIC that will save power and resources. A print server equipped with this new ASIC consumes 15 percent less power than its ordinary counterparts. Furthermore, the number of LSIs needed per server has been reduced 20 to 30 percent, which also contributes to resource efficiency.

Two new series of print servers will be released in May 2000, and each will feature this dedicated ASIC. And by the end of the year the range will include seven models.

Concurrent with the expansion of our ASIC-equipped product line, we will also drive technological development in order to reduce power consumption a further 15 percent. Measures to achieve it include the use of "magic packet" technology (equivalent to the standby mode in a TV) and the perfecting of a low-voltage specification.

Excimer laser

Print server with built-in ASIC