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Feature

Typical Applications of Network Controller "S-MAC" for Servo Press Machine

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1. Introduction

Sanyo Denki made a " Multi Interface Declaration " in November 1996 and has since been promoting the spread of the open system. Using SERCOS and DeviceNet as motion networks, and using Ethernet as a host network, the company has been developing various drivers and controllers compatible with these networks. The networks have now penetrated industrial equipment deeply both abroad and at home, and it is the demand of today's society to incorporate networks into the controllers and servo actuators.

In these flows of the times, this paper presents typical applications of this company's network controller " S-MAC " to a servo press.

2. Overview of a servo press

2.1 Overview

A servo press generally refers to a press whose crank axis has been replaced with a ball screw or other linear mechanism. The press presented in this paper is so designed that its main slide is operated by a cranking mechanism and a Sanyo Denki servo motor is used as the drive. Another feature is that another servo motor is used as the material feeder, thus ensuring a complete synchronization run with the press. This is a typical application using the features of the full software motion control language, AML, which performs synchronous runs by position control in a rotary coordinate system of crank axis and feed axis.

2.2 Specifications

Table 1 shows the mechanical specifications of the servo press, Table 2 its system configuration, and Table 3 its software specifications.

Table 1. Mechanical specifications

Item	Description
Machine model	LEM1703
Uses	For fast, precision fine machining
Capacity	3 tonf
Stroke count	0 to 600 spm (Target: 1,000spm max.)
Stroke length	Fixed (such as 5, 8, 10, 12, and 15mm)
Types of machining	Punching, crushing, bending, contraction

Table 2. System configuration

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Table 3. Software specifications

Item	Description
OS	MS-DOS 6.2
Realtime OS	iRMX
Motion Language	AML Runtime SRX Runtime

2.3 Outside view of the machine

Fig. 1 is an outside view of the servo press.

3. Overview of the control system

The following is an overview of the control system of the servo press.

3.1 System configuration of the control unit

Fig. 2 shows a system configuration of the control unit. The ″ AML ″ target PC, which is a controller, is the ″ SMS-10 ″ of the network controller ″ S-MAC. ″ Fig. 3 shows the ″ SMS-10. ″ This is a PC-base controller compatible with general PCs, but is an industrial PC which Sanyo Denki has developed specifically with conditions that ensure downsizing, a longer life, and higher environmental resistance. It does not use rotary equipment such as a hard disk drive (HDD), and uses a flash memory for its external memory, thus being best suited as a press machine which creats a vibration by itself.

The servo amplifier is a ″ PZ-W, ″ a driver compatible with SERCOS, which is a set of standards for an open motion network. The ″ SMS-10 ″ and servo amplifier are connected by optical fiber and consists of a servo system excellent in wire-saving and noise-resistance. Ethernet is used for network connections with the development environment and other high-level systems. Connections are made by RS-232C communications to HMI-governing liquid crystal touch panels and PLCs that monitor press interlocking.

3.2 Control overview

Servo motors are installed on two axes. One axis is on the crank axis that moves the press up and down, while the other is used to feed the feeder called the gripper feeder. The motor mount on the crank axis is illustrated in Fig. 4, and an outside view of the feeder is given in sFig. 5.

The crank axis is equipped with the absolute value detector which detects the axis angle and also an encoder used to operate the feed axis synchronously when setting the crank axis to the upper dead point manually. The press has five operation modes: hand, off, inching, safe-stroke, and continuous. There is also origin reset mode, which is used for positioning at power-up and after emergency stop. In inching, safe-stroke and continuous modes, the crank axis motor and the feed axis motor are completely synchronized.

Synchronization control is implemented by software using the Drive-Train object in the ″ AML. ″ Therefore, even if the speed of the crank axis is changed on a real-time basis, the feed axis is designed to follow up at all times. Synchronous operation without special hardware is one of the features of the system. To ensure safety of the press, it presents some operation constraints, such as it must always stop at its upper dead point when stopping from a continuous run. Using a servo motor ensures an accurate stop despite the operation speed.

3.3 Features

(1) Complete synchronization of press action

A driver uses SERCOS as a motion network, thus providing a function of synchronizing press and feed actions completely by means of the network.

(2) Higher machining speed

Using a servo motor for the crank axis is expected to increase the stroke from 200-300spm (1spm means one pressing operation per minute) in conventional practice to more than 600spm without sacrificing machining precision and to allow the mold to last longer.

(3) Higher expandability

The full software motion control language, ″ AML, ″ can be used to ensure a synchronous run by means of software. Since network-compatible drivers can be added without adding hardware on the controller, peripherals can be easily added.

(4) Environmental friendliness

The mechanism and hydraulic equipment have been omitted to ensure lower noise and environmental friendliness.

(5) Much easier adjustment and maintenance

The networking of controller and driver has enabled the action parameters of the driver to be integrally controlled by the controller. As a result, networking the system with a host computer facilitates online adjustment, thus greatly shortening the bootup time of the machine.

4. Conclusion

As a typical application of a network contained in industrial machinery, this paper has presented a servo press based on a network controller ″ S-MAC. ″ Combining a network-compatible driver with a servo motor for synchronously driving the crank axis and feed axis enables smooth, accurate rotation and doubles or triples machining speed without sacrificing machining precision. The servo motor is also highly advantageous in environmental terms, so that hopes run high for future developments in the field of models with high press loads as well.

Networks are expected to develop further, including their application in equipment maintenance and remote services, and the authors wish to continue to develop technologies and products capable of meeting these requirements. Last but not least, the authors wish to express their thanks to Noritsu Kikai Seisakusho Co., Ltd. (which is a press manufacturer) and Sanyo Kogyo Co., Ltd. (which is one of Sanyo Denki's agencies) for their cooperation in the course of compiling the present paper.

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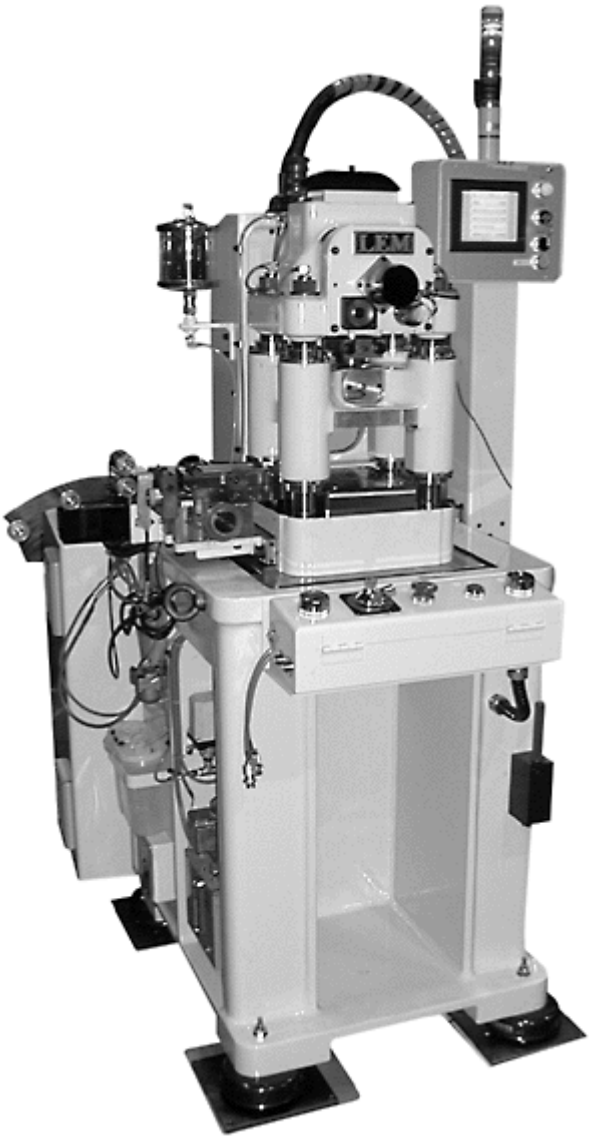

Fig. 1 is an outside view of the servo press.

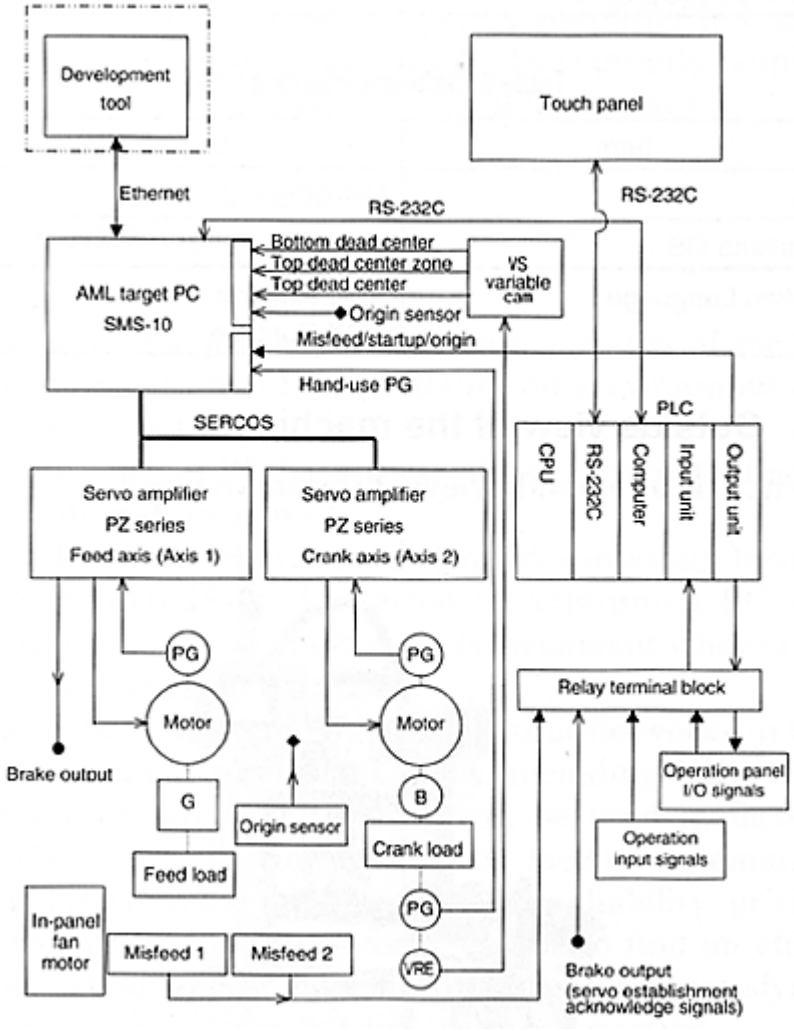

Fig. 2 Block diagram of a system configuration of the control unit

Fig. 3 Outside view of the ″ SMS-10 ″

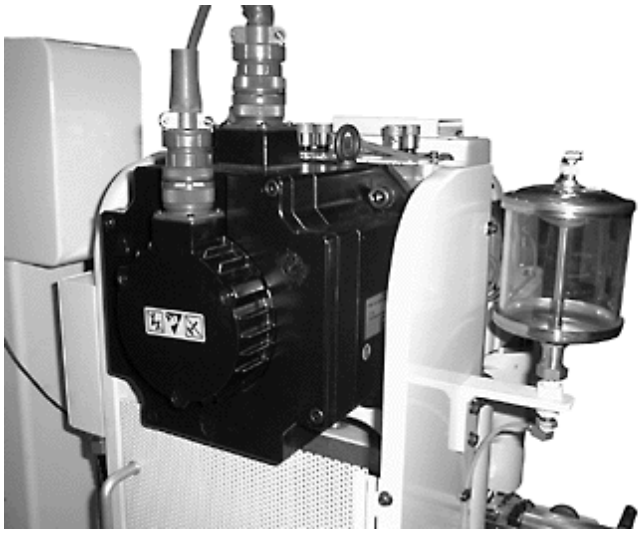

Fig. 4 Crank axis motor

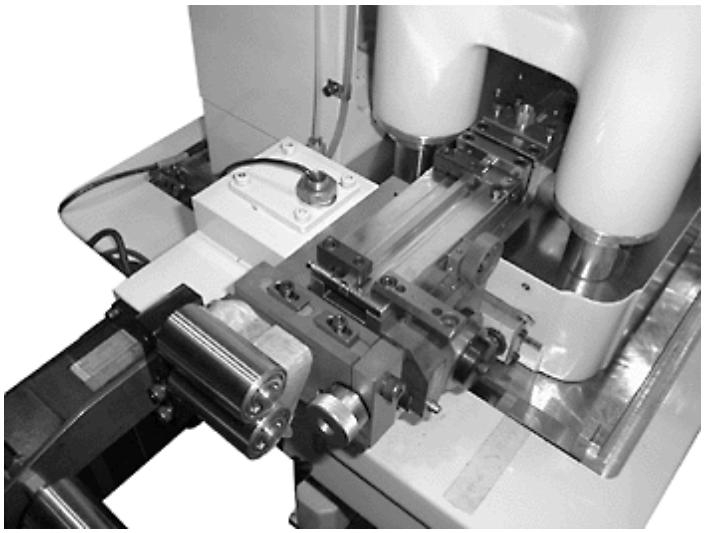

Fig. 5 Feeder