Jim Geren, Enfield, CT, USA

Controlling a Servo IS Machine

The pneumatic IS Machine has served the industry well for some 80 years and continues to do so. Over its life, it has changed with modifications and modernization of mechanisms, increased numbers of sections, and the introduction of electronic forming control interfaces. While these improvements enhanced the productivity of the IS Machine, there was still something missing: true control of the forming process. The NIS servo IS machine was developed to allow the container forming industry to take the next steps toward total process control and a final goal of completely automated production of containers.

Introduction

In the NIS Machine, all section mechanisms have been designed to be controlled by AC Brushless motors rather than pneumatic valves and cylinders. Clearly, there are still some pneumatic functions on the NIS, so the control system, in addition to being able to direct the operation of all of the servos must also be capable of controlling discrete inputs and outputs.

System Architecture

In order to achieve the desired results with the NIS Machine, some basic design and architectural tenets were established:

1. The system should be designed with as few electronic modules as possible
2. Simple to use operator interfaces must be designed and employed
3. Ethernet protocol must be used
4. Mechanism over-rides must be located on machine mounted panels (Blankside and Blowside)

In Fig. 1, the system architecture is shown. It is evident that there are only two major control system elements: the General Purpose Control Module (GPCM) and the Amplifier Module.

The Universal Console acts as the main operator interface as well as the system coordinator. The console is connected to the system components using ETHERNET protocol (100 base T). The GPCM (General Purpose Control Modules) units shown are Pentium™ class processors and are used for all system applications requiring computing power. Commercial Pentiums™ were chosen because as motherboards improve (e.g. Pentium™ 3 to Pentium™ 4), these future versions will remain software and hardware compatible with the installed base and will be transparent to the user. In Fig. 1 it is shown that the GPCMs are bus connected to the amplifiers for running all of the section related servos, in fact all machine related servos as well as those for the drive system, gob forming, and gob delivery functions.

The amplifier was designed to have the capability of controlling AC Brushless Motors of ratings from fractional horsepower to approximately 7 horsepower. Programmable torque and current limits allow this amp to be applied to such a wide range of motors. Each servo amp has its own DC power supply to eliminate the possibility of a single point of failure. In addition, the amplifier is capable of interfacing both encoder and resolver feedback devices.

By using the GPCM and amplifier for all applications, two basic advantages are provided to the user:

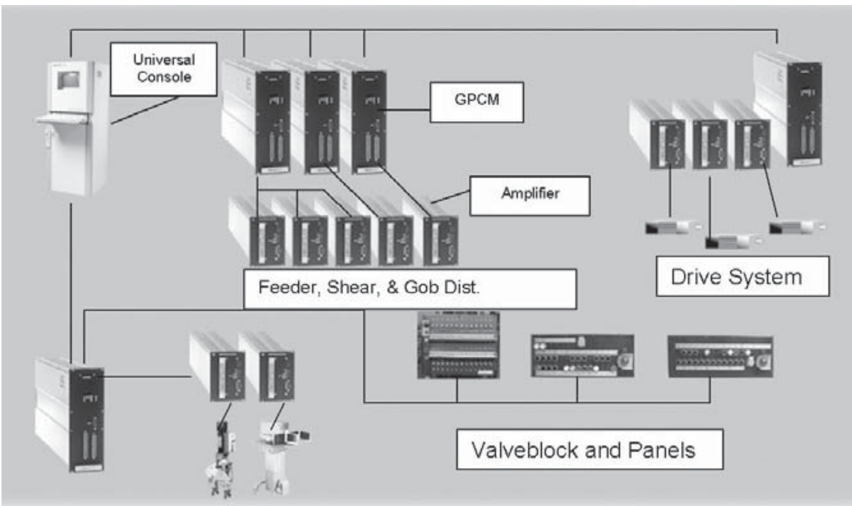


Fig. 1: Overall system diagram

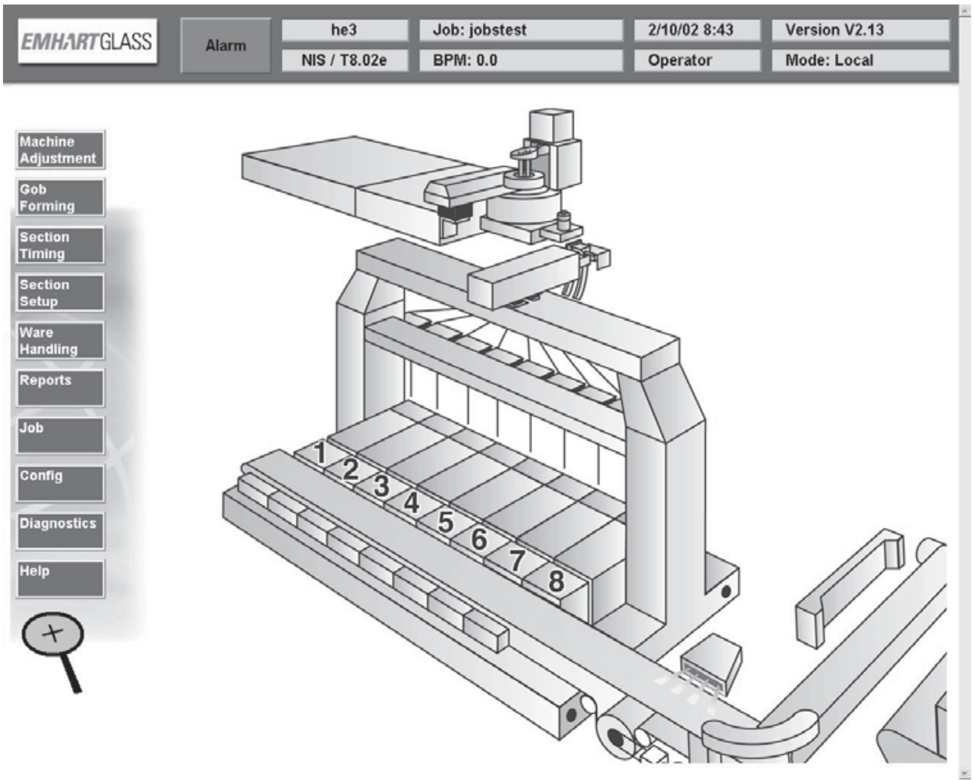


Fig. 2: User display home page

- Educating maintenance people becomes much easier because of the commonality of components
- Spare parts stocking is less costly, and minimized

A GPCM per section is used to co-ordinate the operation of the individual section making each section independent of the next. Coordination of overall machine operation takes place at the universal console and is transmitted to the sections over ETHERNET.

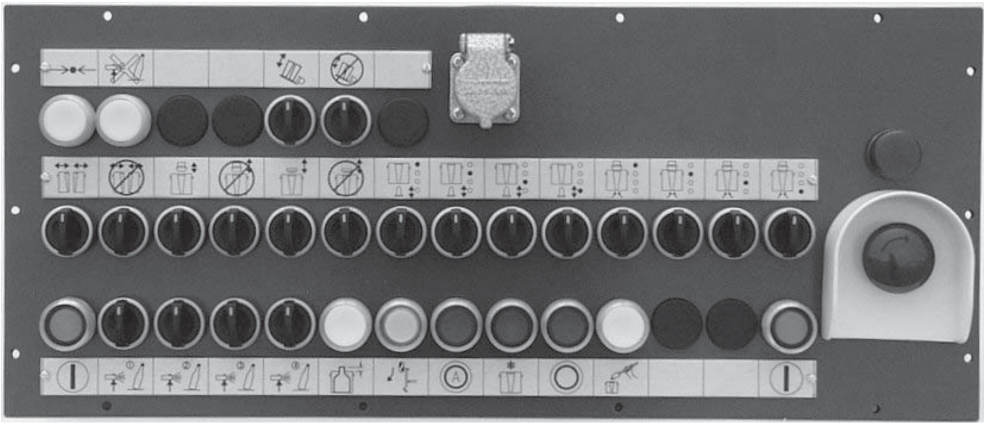
The Operator Interfaces

The operator interfaces for the servo machines consist of the Universal Console (UC), the Hand Held Terminal (HHT), the Blankside Overhead Panel, and the Blowside Panel.

The UC is really the main operator interface. For operator convenience, a touch screen is provided. A sophisticated system of pull down menus and context sensitive screen areas allow for rapid system navigation from data item to data item. A simple point and touch brings the user immediately to the screen that he desires. System reports for the NIS machine are handled through a sophisticated program called Flex Reports™ which has access to all database items available Fig.2 portrays the main screen layout and is the main user interface point.

Fig. 3: HHT

The provided Hand Held Terminal (HHT) was designed to be a simple, portable operator interface for use close to the operating NIS Machine. In Fig. 3 it is easy to see that the terminal has a minimum number of keys and the use of icons helps with multi-language applications. The terminal interfaces through conveniently located terminal connectors at the machine sections. This allows for precision mechanism setup right at the section where the operator can clearly see the mechanism operation and make adjustments as necessary. The HHT is also invaluable in setting up the gob delivery when initially starting a machine.



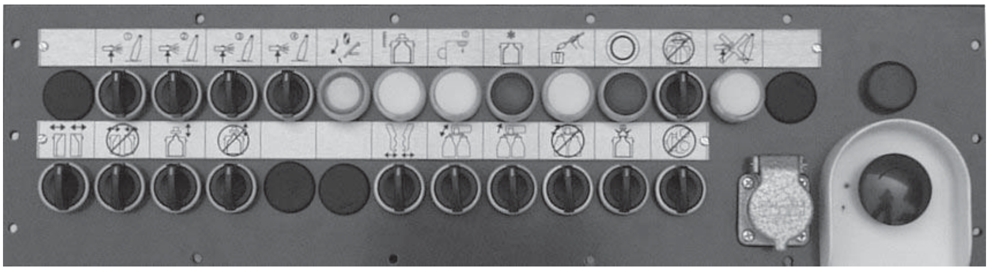


Fig. 4:
Blankside panel face,
Blowside panel face

The operator panels themselves have the same functionality as the panels used for electro-pneumatically operated machinery. The key difference is that there are electric over-ride selector switches for each of the mechanisms to allow for manual operation. In addition, there are also switches to inhibit any mechanisms' operation. If the section had maintenance work (e.g. change of a mechanism) it is possible to initiate an automatic calibration cycle for that section's servo-mechanisms from the panels. Special cycles can also be initiated from the operator panels. These cycles include: Cold Molds and Cold Blanks; Swab Cycles, both Blankside and Blowside; Finish Measure (parison freeze); blowhead adjust cycle; neckring change cycle; and a blowside special cycle to facilitate starting a cold section. Ware reject can be initiated for a preprogrammed number of containers from each cavity to be rejected from each side of the machine. Continuous ware reject can be set as well as cancelled from each side of the machine.

Conclusion

With the commercialization of the NIS Machine we have fulfilled our goal of creating an advanced machine using a minimum of components with sophisticated user interfaces. The NIS gives the glass container industry not only a new and better machine, but a stable platform for future developments. Because it is an electronic machine, precise control of the mechanisms is a given. With this precision control, optimization of the forming cycle along with controlling mechanism motion profiles will lead to shorter forming times and less damage to the containers during the forming process.

The standard platform that has been established gives rise to the development of performance enhancing software programs. The first to be released will be a cycle time optimizer that will minimize dead time in the cycle without effecting the quality of the container produced. Tests that were made on a large cross-section of existing jobs have shown performance improvements of up to 8%. Additional programs will follow on a timely basis. Going forward, most new developments will be in software enhancements to improve performance and machine longevity.

The NIS Machine, as it stands today, revolutionize glass container production and will continue to do in the future.

Further information/Author:
Jim Geren, Director of Marketing
for Controls and Software,
Emhart Glass Manufacturing Inc.,
89 Phoenix Avenue,
06082 Enfield, CT, USA,
T: 001 860 814 4010,
F: 001 860 814 4170
At the glasstec in hall 14, stand D70.