WHEN THE FIRST IS MACHINE WAS INVENTED IN 1924, IT REVOLUTIONIZED GLASS CONTAINER MANUFACTURING. THE DEVELOPMENT OF THE AIS MACHINE, ALMOST 50 YEARS LATER, FURTHER REVOLUTIONIZED THE INDUSTRY WITH THE PARALLEL MOULD OPEN/CLOSE MECHANISM, FOR HIGH FLEXIBILITY, SPEED, EASE OF USE, AND IMPROVED GLASS CONTAINER QUALITY. THE MID-1990s SAW A FURTHER MOVE TOWARDS FLEXIBILITY AND EASE OF CENTRE DISTANCE CONVERSION ON AIS MACHINES, WITH THE INTRODUCTION OF THE NEW GENERATION OF PARALLEL MOULD OPEN AND CLOSE BRACKETS.

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The Beginnings

In 1928, a British trade journal published a short article with photographs of the newly-invented IS machine. The last page of the story included the words “to be continued,” but nothing more was written. Maybe, at the time, it seemed that such an invention was too good to be true.

The report noted that “as a result of a study of the principles involved in producing a bottle and examination of existing methods, the Hartford Empire Company (which, years later, would be known as Emhart Glass) came to the decision that it was necessary to evolve an entirely new type of machine to... provide the glass manufacturer with an equipment which would enable him to handle a range of large and small orders with equal or greater efficiency and productive economy, than are available for large quantities.” (1)

For half a century, the IS machine remained largely the same as it was when Henry Ingle and Goodwin Smith filed the first US patent application for the innovation in 1924.

The AIS Machine

In 1976, Emhart Glass developed the next major innovation in IS machine technology, the Advanced Individual Section, or AIS, machine. The AIS was designed around the latest pneumatic technology, and set the stage for the later development of the NIS machine, the first fully servo-controlled IS machine.

What makes the AIS unique is its use of parallel mould open and close mechanisms. Unlike standard IS machines, in which blank and blow moulds open and close on an arcuate path, using a hinged assembly, AIS mechanisms open and close in a parallel motion. The result is an improvement in forming speed, more equal cooling condition, and less wear on the blank and blow sides of the machine.

Wear Points

One of the most significant wear points in an IS machine are the mould open and close system, and the mould supporting mechanisms. The higher the forces, the greater the wear. This effect leads to accelerating wear and the need for careful monitoring. The mould supporting mechanisms are most vulnerable to wear, particularly the following:

- link-pin bore in lever;
- link-pins;
- bores of connecting link;
- bore in the mould holder arm for connecting-pin; and
- band diameter of the mould.

Special maintenance instructions are required to manage their wear points. With the arcuate mould open/close of the standard IS machine, the holder arms function with pivoting action and wear affects the mould centres (Figures 1 and 2). Mould centres on standard IS machines can deviate from their correct position due to thermal expansion between 0.5 and 1.0 millimetres and, due to wear, by up to 0.8 millimetres.

By the nature of the IS machine link geometry, only approximately 65 per cent of the force generated by the MOC is translated into mould closing force. The geometric configuration of lever and link used for the AIS parallel mould motion results in most of the generated force being directed into the closing force. As a result, forces generated in the AIS machine are more efficiently used than is the case for the arcuate mould open and close of the IS machine.

The key feature of the parallel mould motion is the equal and gentler handling of the moulds. As shown in Figure 3 on a 61/4 “DG configuration the travelling distance of an AIS mould (VA) is only about half the distance of the inner mould (VI) of an IS machine. This not only reduces the travelling speed but, together with the absence of the inertia acting on the moulds, as is the case by the arcuate motion of an IS machine, also leads to significantly reduced mould wear.

Mould diameter wear, insert diameter wear and heat elongation have no effect on blank “dictum.” The relation between blank and plunger centres is thus greatly maintained. Aligning difficulties, caused by heat elongation of mould holder arms and inserts during section start up are, by design, not an issue on the AIS machine.

Besides reduced wear due to improvements in mould handling, the parallel MOC also provides identical thermal profiles on all moulds, parisons and containers. Radiation heat is proportional to the 4th power of the distance from glass to mould (Stefan Boltzman). All moulds move during opening and closing at the same distance to the glass.
The 26-line electro-pneumatic valve block, in conjunction with the optimized air supply and exhaust piping on new AIS sections, gives potential for increased forming speed.

The AIS is also designed to meet customers' requirements for flexibility, because today nobody can be sure what kind of containers will be produced next. This machine can be easily converted, something not easily achieved with an IS machine. A typical conversion from DG to TG or from TG to DG can be accomplished in less than six hours.

With nearly 100 machines now under glass, the AIS is becoming a cost-effective conventional glass forming machine alternative for glassmakers.

As with the development of the IS machine in 1924, the AIS was part of a design philosophy that put customers and quality first by re-thinking conventional ways of doing things. As noted in the trade journal article from 1928, “in order to get the flexibility of operation that was desired and at the same time keep the machine simple, ... it was necessary to abandon rotating tables, fixed cams, etc., and also get away from a design in which, as in existing rotary machines, the various movements of the operation parts were timed in fixed relationship with one another...” (1)

The AIS meets this design standard by providing glassmakers with a machine that responds to the need for flexibility, improved productivity and reduced wear parts, while simultaneously providing a tool that has a high potential to improve glass container quality.

REFERENCES


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