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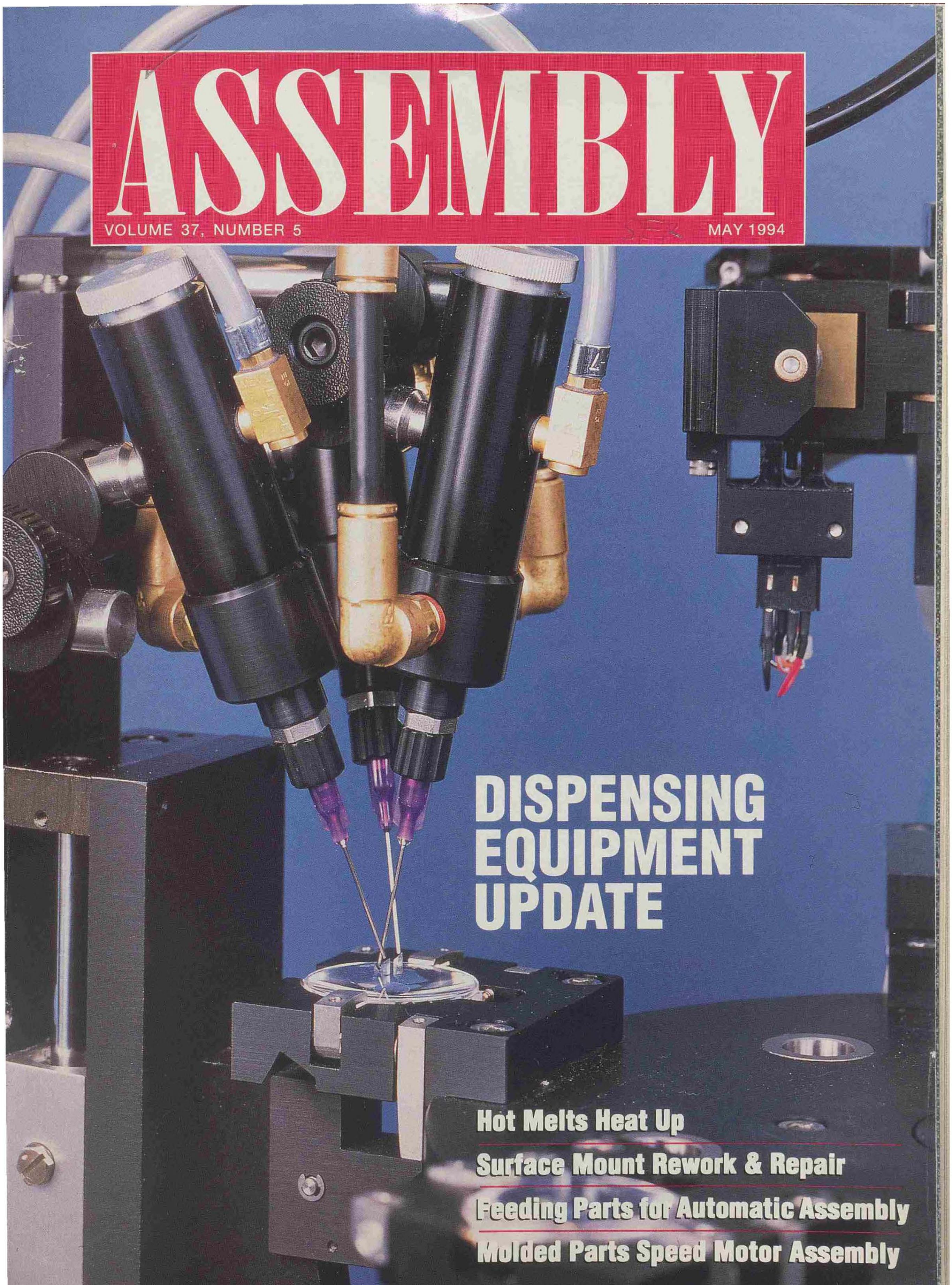

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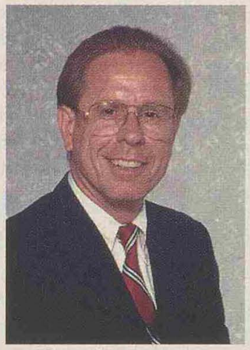
No Blame, Big Gains



Reinvention. It's today's buzz word. President Clinton talks about reinventing big government. And companies from IBM to mom-and-pop enterprises are reengineering themselves—redesigning processes, structure, and culture—to compete in a tough economy.

To steer a proper course, a company needs to understand its most detailed workings, says Leonard Bertain. He heads a productivity consulting firm and authored *The New Turnaround*, a "business novel" based on his experiences.

"A company needs to understand the degree to which its current processes and culture are a part of the problem," says Dr. Bertain. "Only then can meaningful reinvention occur."

He feels that many companies are confused by the business cultures they have created. The ideas that helped them grow and succeed in the past now hinder them.

"Big companies achieved revenue growth, but didn't grow in their ability to effectively adapt to change. And small companies that copied big companies have often downsized in lock-step with them," Dr. Bertain explains.

Lack of ideas doesn't deter companies from becoming high performers. What's lacking, he says, is a clear understanding of what to change and how to implement change.

One of the biggest barriers to becoming competitive, Dr. Bertain continues, is that people spend too much time placing blame, and defending sacred cows.

"When management and labor are not pointing fingers at each other, they are pointing at unfair foreign competition, inequitable trade practices, government regulation, lack of government regulation, over-hyped productivity philosophies—and just about anything else that will distract attention from industry's collective responsibility," Dr. Bertain asserts.

"TQM, JIT, SPC, TOC, and synchronous manufacturing are all useful tools for dealing with the demands of the competitive global marketplace. They are not the problem. It is the assumptions built into our business culture that have tainted our adaptation of these improvement philosophies."

For example, he says, the majority of American managers feel that thinking is not part of most workers' job descriptions. Dr. Bertain proposes a prerequisite for meaningful, long-term improvement: a strong, no-blame approach "to set aside fears, and facilitate progress."

Perhaps your company should encourage all employees to work together in a positive, no-blame environment to reinvent the kind of culture that you need to succeed. There is nothing to lose, except the barriers between you and the big gains that come from no blame.

Allan Benson

Molded Parts Speed Motor Assembly

Motor manufacturers increasingly use engineering plastics to develop stator advancements.

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Recent innovations in motor design use engineering plastics. For stators, motor manufacturers are following two main paths to reduce costs and improve reliability with engineering plastics. One path involves separately molded multifunctional components; the other employs insert molding to encapsulate the stator, while simultaneously building in assembly functions.

Driven by needs to hold down costs and improve reliability, motor manufacturers increasingly integrate engineering plastics into their products. In papers presented at recent EMCWA conferences, we have reported innovations in several areas:

- Multifunctional end brackets that integrate insulation, structural, bearing, and assembly features;
- Bearings that eliminate separate lubrication;
- Rotors and stators using molded components to replace paper, film, thermosets, or other traditional materials.

Recently the pace of innovation has quickened in stator design and construction. Producing traditional stator designs is highly labor intensive. It requires handling and placement of flexible slot insulators, and other components such as pultruded thermoset pins or tie cords, to secure field coils to laminations. Terminating the field coil's magnet wire to a lead wire is often a manual operation.

To reduce stator assembly costs, motor makers are increasingly turning to engineering plastics—either separately molded components or encapsulation materials.

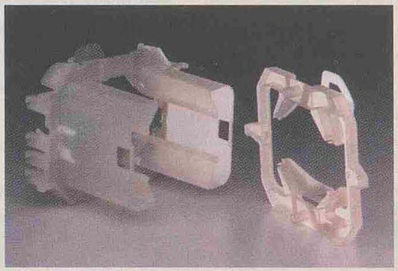

Figure 1: Molded stator parts for washer motor.

Multifunctional stator parts

Separately molded stator components of engineering plastics offer several ways to cut assembly costs, while allowing use of the same parts in different motors.

Recently, several motor manufacturers have adopted molded end insulators with integral pockets for automated termination. The pockets offer a notch or slot to hold the magnet wire end while a machine inserts a metal terminal. Such components are used in stators employing conventional flexible slot insulation.

Figure 2: Assembled stator for washer motor.

Motor builders can further economize on labor input by eliminating flexible slot insulation, and by integrating that function into a combination end/slot insulating component. The parts shown in Figure 1 reflect this approach. They are used in the stator (shown partially assembled in Figure 2) for a universal motor that powers Miele of Germany washing machines.

The larger, more complex Miele components integrate end and slot insulation, termination holders, and provisions for snap-lock assembly. Another part at the opposite end of the lamination stack from the larger component has integral snap-locking detents and coil supports, too.

Both components are injection molded in an unreinforced 6,6 nylon resin, part of a pretested, preapproved UL Class B (130°C) system evaluated in according to IEC Publication 85. This saved the manufacturer time in obtaining necessary approvals to meet electrical safety requirements of various countries.

Encapsulation: one-step production

Given sufficient volume to recover tooling costs, insert molding technology offers the ultimate in designing stators for a minimum of assembly steps and cost. The process involves placing the steel laminations in an injection mold, and then filling the mold with thermoplastic material. In a single step, the process locks the laminations together and forms end and slot insulation, coil supports, and assembly features such as winding guides, terminal holders, screw bosses, and mounting brackets components.

Besides cutting costs, insert molding is simple and relatively easy to control. By eliminating various separate components and operations, it avoids multiplication of tolerances, and thus promotes consistency of quality and product reliability.

Several examples show how motor manufacturers use insert molding to achieve the features and benefits of thermoplastic encapsulation.

■ **AC induction motors.** The stators shown in Figures 3 and 4 serve in AC induction motors for fans for commercial refrigeration equipment. Both were developed by Electric Motors and Specialties, Inc. (EM&S), Garrett, IN.

The unit in Figure 3 is for a 10 W, split-capacitor motor for condenser fans. The slot/end encapsulation part has integral posts that double as supports for a terminal board and as winding guides.

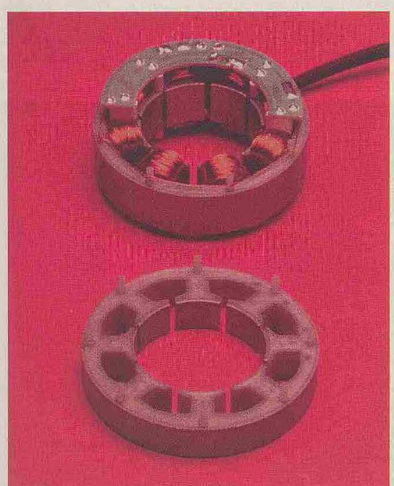

Figure 3: Encapsulated stator for 10 W split capacitor motor.

EM&S formerly encapsulated an earlier version of this stator with an epoxy powder system. Switching to thermoplastic encapsulation reduced costs by eliminating the need to tumble-finish and preheat the laminate cores prior to coating.

The stator in Figure 4 is for a 25 W shaded pole motor. In addition to end and slot insulation, the one-piece design incorporates contoured winding slots for accurate placement of windings, and permits effective use of slot space. Termination holders are also integrated in the design.

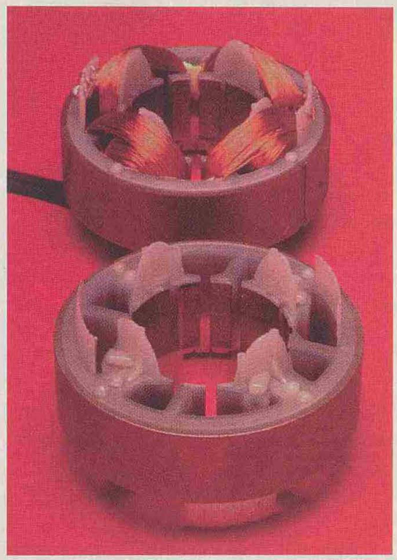

Figure 4: Encapsulated stator for 25 W shaded pole motor.

In a previous construction, the stator used a paper/film composite for slot insulation, and separate parts for coil supports, end insulation, and termination holders. Thermoplastic encapsulation reduced part and assembly costs while improving quality, says EM&S.

Both stator designs are encapsulated with a nylon resin. It provides high productivity in the insert molding process, and is part of a pre-approved insulation system for Class B (130°C) service under the UL 1446 standard.

■ **Universal motor.** The stator shown at the right in Figure 5 is for a universal motor used in a meat grinder produced by S.E.B. of France. The encapsulation material not only provides end insulation but fulfills structural and assembly functions.

Figure 5: Encapsulated stator, end bracket, and spider for meat grinder motor.

The coil supports at both ends have integral flanges to fix the magnet wire's position. Slotted termination pockets hold magnet wire ends and are configured to hold standard metal terminals. Through holes facilitate subsequent assembly of the stator to end brackets.

The resin used is a thermoplastic polyester, flame-retardant material based on polyethylene terephthalate (PET). It is part of preapproved UL 1446 systems for service up to Class N (200°C). S.E.B.'s meat grinder motor is engineered for Class H (180°C) service.

The end bracket and spider shown at the left and center of Figure 5 are injection molded of the same material. The bracket design also incorporates numerous molded-in functions. They include an integral bearing pocket, retainer posts for the brush spring, fingers for a capacitor, brush wells, several screw bosses, and a mounting bracket.

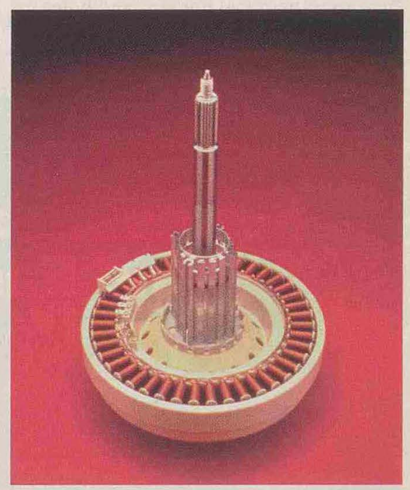

Figure 6: New brushless DC washer motor uses large encapsulated components.

■ **Novel DC brushless motor.** New Zealand's leading appliance maker, Fisher & Paykel Co., has implemented automation opportunities of insert molding in a radically new kind of brushless DC motor. Used in washing machines, it (Figure 6) is electronically controlled and directly drives the washer's agitator and spin bowl through a patented clutch. This eliminates a complex gear case required with a fixed-speed AC motor.

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