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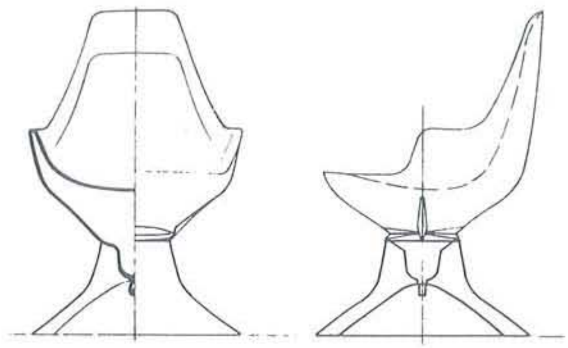
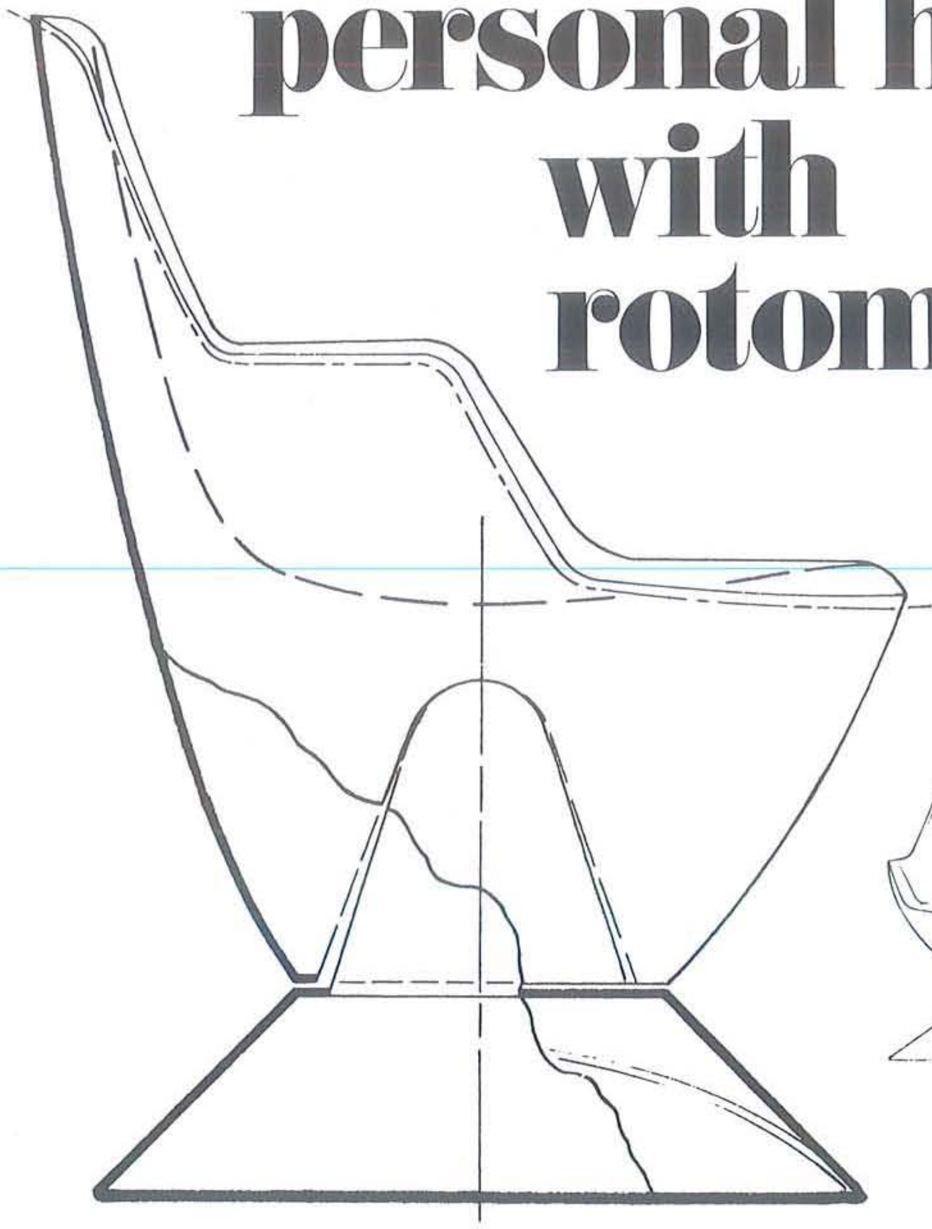
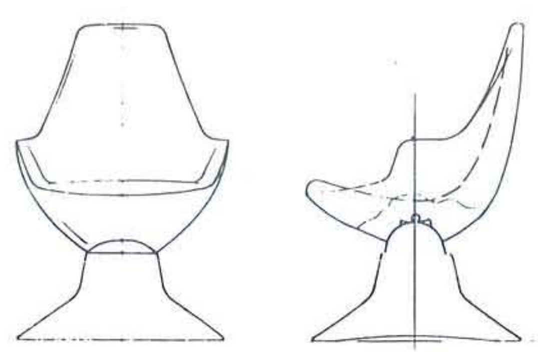


A designer's personal history with rotomolding





A designer's personal history with rotomolding

Figure 1

In relating his own experiences over the years—some successful and some not—John Gale suggests how designers can best contribute to the product-development function. These experiences may prove valuable to designers working with other processes.

My first brush with rotational molding was strictly a speculative venture, but with a bit of beginner's luck it turned into a modest success over a number of years.

The story starts in 1962, when I'd been designing large blow-molded utility containers on a consulting job. One day I happened to sit down on a sample molding in the office. Hey, I thought, what a slick way to make a chair! In fact, why not a swivel chair?

I chuckle now at my first sketches (for example, see Figure 1), but I figured it would be a lot less expensive to experiment with a kid's version at the beginning. I'd never heard of rotational molding and didn't know a whole lot about blow molding, but I decided I was going to blow-mold this chair.

Author: John Gale, president, John Gale Co., Excelsior, Minn. Adapted from a talk at the annual meeting of the Assn. of Rotational Molders.

Remember, I had a good thing going for me—I didn't know what couldn't be done! So I just plunged in, and after a lot of noodling and rehashing I came up with a design that had a couple of neat gimmicks: the base and seat portions were to be joined by a pop-it designed as an integral part of the moldings, and I decided to add a little tilt action—hence, the nice bellows effect fore and aft (Figure 2).

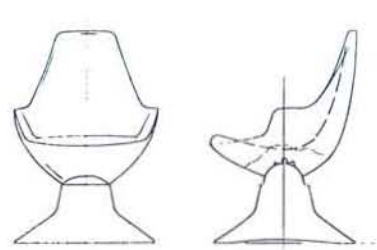


Figure 3

I had a friend make me a couple of patterns, and I hit the road in search of the right blow-molder... Suffice it to say I was not immediately recognized as the Leonardo da Vinci of the plastics industry. Beating a hasty retreat back to the drawing board, I had a chance meeting with a chief engineer from a nearby company newly involved in the rotational molding of hobby horses.

It was my first encounter with the process, and it took a day or so for the significance to set in. When it did, I realized that rotomolding had some fascinating possibilities. I decided I needed a new design to exploit these possibilities (Figure 3) and a new set of patterns.

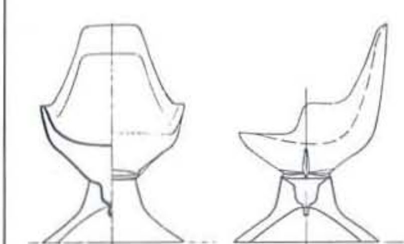


Figure 2

After analyzing the design and obtaining a pattern revision (Figure 4), I wasted no time in ordering the first mold set. Within a few weeks, the first samples were run.

(continued)

Figure 4

A few ‘dos’ and ‘don’ts’

Many designers have their own lists of dos and don’ts in designing products to be manufactured by the different plastics processing methods.

Following is one man’s list of dos and don’ts with regard to rotational molding:

Do design closed-draft moldings (enclosures), for rotational moldings, ***except when:***

1. The product is to be manufactured in relatively high volume but does not call for extremely fine details, in which case the higher cost of blow-molding tooling may be justified. Typical products in this category include small bottles or large trash containers.

2. The product is relatively large, the volume is low, but the design characteristics and functional logistics indicate that assembly from multiple components via other open-draft methods, such as reinforced plastics layup or thermoforming, may be justified. Such products might include shower stalls or K-D outside-storage structures.

3. The product is relatively large, and functionally feasible as a rotationally molded item, yet the volume is high enough so that lower combined piece-part cost or assembly cost might justify the higher tooling cost of structural-foam or injection molding. These products might include shipping containers or industrial pallets.

Don’t design open-draft products for rotational molding, ***except when:***

1. Production volume is so small that the higher-cost tooling of other methods is not justified.

2. The depth and detail of low-volume products is such that vacuum or thermoforming cannot meet the requirements.

3. The product is so large that it exceeds injection-molding limitations.

4. The product does not require such physical characteristics as surface finish, abrasion resistance and rigidity, which can be better achieved in reinforced thermosets.

5. The product, as an individual item, might be more economically produced by another method, but the ability to produce multiples in one operation followed by secondary separation makes the product competitive in rotational molding.

This list still leaves an ample number of situations in which rotational molding will go unchallenged.

Let’s say your product concept seems to have a good chance of qualifying under the above criteria. What next?

All too frequently rotational molding design fails to take full advantage of the technology. For example, take an item that had been previously fabricated in sheet metal. Too often the plastics item is simply a duplication of the original shape. Of course, if you’re using sheet-metal molds, the natural inclination is to limit the design to the capabilities of metal.

But even if the plastics end product can do as well as the sheet-metal item it replaced, the designer should explore the possibilities of developing a superior product by using the technique of rotomolding to provide structural functions as well as applications not available in other methods. These include:

1. The ability to provide joining as an integrated part of the molding.

2. The ability to provide integrated framing and support elements within the molding itself.

3. The ability to include accessory components as part of the parent molding.

(Other benefits might include the use of molded-in inserts and molded-in color and finishes.)

To illustrate the “dos” and “don’ts” principles and the special rotomolding capabilities with an actual product, let’s consider a trash container (Figure 1). It was a sensational failure and made a noteworthy contribution to the collapse of its producer.

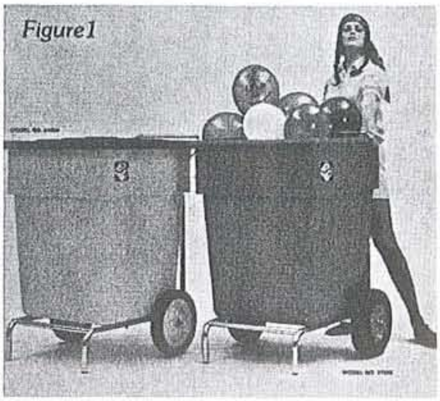


Figure 1

According to our lists, this product does not qualify under the “dos” because it’s an open-draft molding. So we move to the “don’t” column and find that we don’t design open-draft products for rotomolding. But what about the exception rules?

The container does not pass Rule No. 1, because it was competing in a potentially huge market and nothing in the design prevented injection or even blow molding from doing the job at a better price.

The trash container might have passed Rule No. 2 in a low-volume market.

The initial result (Figure 5) was not exactly an unqualified success. The routed female side of the pop-it was saved from total disintegration on the seat bottom only because the peripheral line where the shell lamina joined the ball socket failed first—about 30 seconds after our first child test pilot went to work on it.

The neat little ribs on the socket surface were the final version of what I’d planned for the tilt mechanism; they were the one element that was supposed to move, and as anybody who knew what he was about could have told me, they didn’t move at all! To make matters worse, the pop-it on the base was so small that if it didn’t disengage first, it simply broke off.

So again, back to the drawing board, where I decided to make the pop-its larger, with a 7-deg conical shape, which meant a 7-deg backdraft on both parts. As for the stress failure at the ball socket edges—that was a real problem.

Discarding the tilt feature made it possible to establish a peripheral bearing surface on both parts to stabilize the joinery, but this did nothing to prevent the socket failure. I was about ready to scratch the whole project when I reasoned that if I could somehow redistribute the stresses up and away from the socket, I’d have her licked—so I gave it one more shot.

Figure 6 shows the result of that very worthwhile final effort. I put four radiating ribs at 90-deg increments, and headed back to the pattern shop and to the foundry with two brand-new molds. You can bet my bookkeeper was beginning to look at me a little strangely.

But what do you know! The new design worked. In fact, the “Swivits” (Figure 7) looked so good that we almost immediately licensed it to the molder who

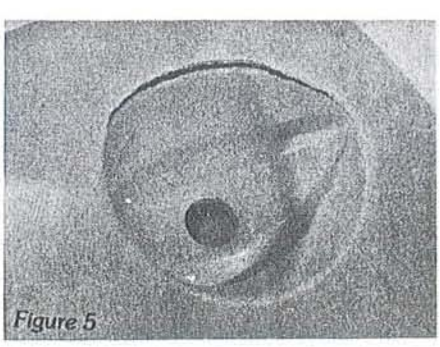


Figure 5

It obviously does not pass Rule No. 3, might pass No. 4, and fails to pass No. 5. Ironically, the entire unit might have been produced as an enclosed molding, with the cover integrated and then separated following removal from the mold. Our molder chose instead to purchase the cover independently from an outside source, as a vacuum forming.

I'd be the first to agree that hindsight is a rather easy virtue, but I think our case history points up a serious oversight on the part of the designer. What could have been done differently?

Let's check the design against our list of rotomolding's special capabilities. First, the ability to provide integrated joinery.

I would design a snap-in retainer in the bottom to relieve the axle (see Figure 2). The problem of actual backdraft could be minimized because the elements themselves are extremely open and do not directly oppose each other. Special work might be required on the mold castings, but this would not be a major problem.

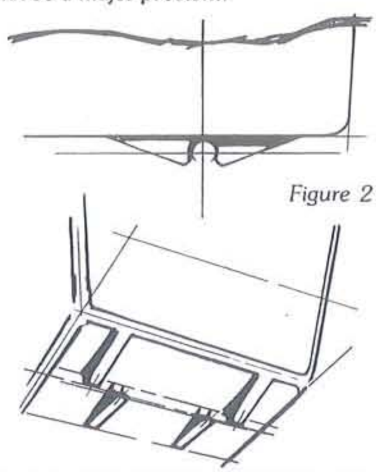


Figure 2

Part removal with low- or medium-density materials would be relatively easy. Keep in mind that one could always make up a small temporary partial mold to check the elements in question. This would help to determine the design's feasibility and also allow for some testing and optimum design refinements. The opportunity for low-cost mold testing and product trial and error is one of the advantages of rotational molding that may not be fully exploited by designers and molders.

Now let's measure the product against rotomolding's special capability No. 2—providing structural and support elements as an integral part of the molding. Here it seems to me the container bottom might be extended downward to eliminate the need for tubular supports or legs (Figure 3). At the same time, incidentally, a nice gain could also be made in container capacity.

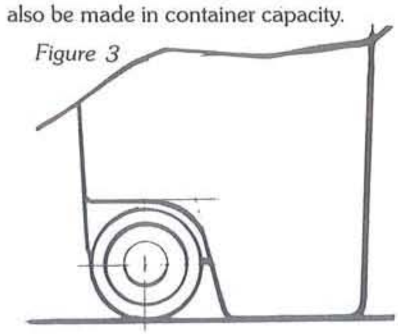


Figure 3

Advantage No. 3 relates to the inclusion of accessory components in the same molding. Why not include the handle, thereby eliminating the tubular structure entirely, with all the nuts and bolts, and all the secondary hole drilling (Figure 4)? Special attention to allowing for material flow into the handles would be required, but this wouldn't be an insurmountable problem.

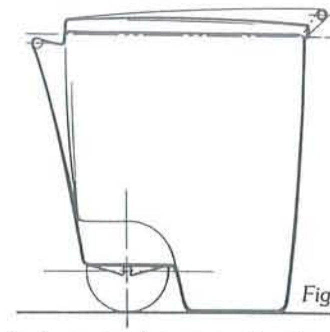


Figure 4

And why not make it an enclosed molding and include the cover, and for good measure add a handle in the cover on the side opposite the container handle? After removing the container from the mold, all that would be required would be separating the cover, rotating it 180 deg, and snapping in the wheel assembly (Figure 5). (Incidentally, why not also rotomold a big roller type wheel?)

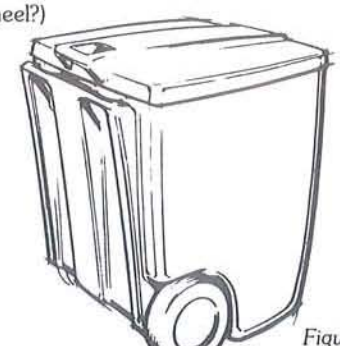


Figure 5

These suggestions all need refinement, but everything discussed here is well within the capabilities of rotational molding and would result in a superior product at far less cost than the original design. And the trash container would certainly have a fighting chance to be a commercial success.

had been doing our sample work for us.

You might ask what it was molded in. All I can say is that it's low-low-density polyethylene. At the time I don't think any of us even knew there might be anything else; maybe there wasn't. There was no scientific engineering input or stress study—just a combination of an intuitive and enthusiastic three or four people working together, depending upon good instincts and trial and error.

As a sidelight, we were able to take the "Swivet" top and adapt it as a fixed-leg chair (Figure 8), using a compression washer retainer. Although it was something less then a runaway success, it was an easy experiment that cost little.

I was given a "Swivit" from the first

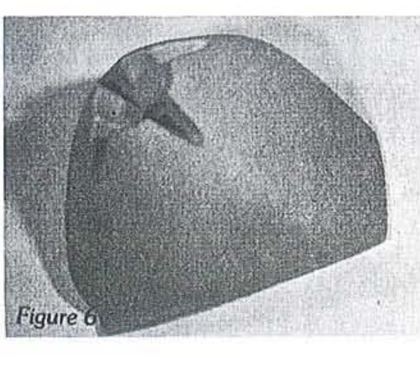


Figure 6

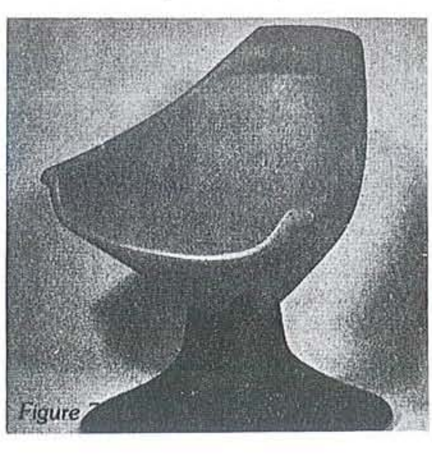


Figure 7

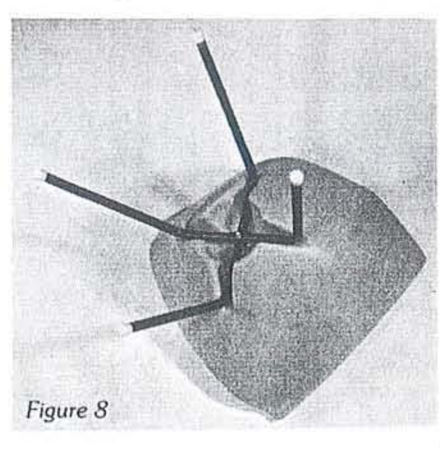


Figure 8

production run. It is 14 years old and has been used and abused by all my kids and their friends, and I think it may even last through a few grandchildren. The swivel fit has become a little loose over the years but she holds together.

Needless to say, we were sold on rotational molding, and having accidentally gotten into the kids' market, we got carried away.

The little blue car in Figure 9 was a real "barn-burner" that almost left us hanging by our thumbs! Remember the

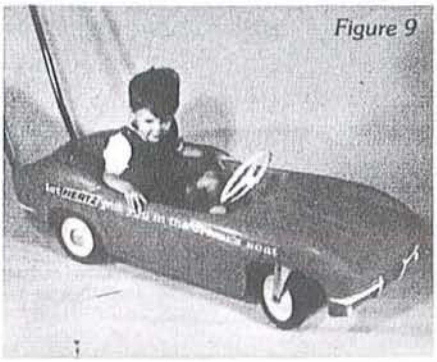


Figure 9

great New York World's Fair of the early 1960s? Well, my memories of it are a little mixed.

A nice chap called on us one day and said he had a deal to supply Hertz with 1000 Corvette "kiddy cars", that he had no designs and his company didn't know how to make them, but someone had told him we were rotational molding experts. I didn't argue because, after all, I'd known about rotational molding for eight months. My visitor asked if we could deliver the first 100 "kiddy cars" to the Fair by April 15. Like a damn fool, I replied, "No problem."

We had three months to meet the commitment. With an effort that was no less than heroic on the part of all concerned, we made good on the April 15th delivery of the first 100.

About a week later I got a nearly hysterical call from our client. It seems that the front ends of all the Hertz Corvettes were breaking off when the fairgoers who rented them decided to transport all the kids in one vehicle. It also turned out that a little cutting around the front wheel axle area made necessary by an axle redesign after mold delivery resulted in some nice square knife cuts that just kept right on going when the kids piled on!

We figured out a wire-bracket reinforcing system, and I was getting ready to fly off to Flushing Meadows to make the field repairs when I got another call—unpack! For once I was grateful for petty larceny—New York style. Most of the first shipment of 100 had been stolen right out of the fairgrounds!

In my book there's another kind of product to watch out for. One that seems to meet all the "do-don't" criteria, takes maximum advantage of the abilities of rotational molding and, in fact, may have all the earmarks of a sensational engineering success—yet turns into a dog in the marketplace!

Figure 10 is an example: a nice little half-scale pool table. When we worked this one out, we thought it was a real honey. There were no separate fasteners; the legs inserted through the bottom (Figure 11) and were fixed in receptacles molded in the top lamina. Ball returns were molded in, with balls dropping to the inside of the molding (Figure 12) and rolling to the return rack at one end.

At the opposite end was a ball storage rack, and shelves for the cues were on the sides. The felt-covered hardboard playing-surface locked in with a vinyl extrusion and also held the neoprene bumper, and itself was locked into back-drafted slots in the molding. Beautiful, huh?

Well, what went wrong? We found we were dealing in the miniature market, where everyone else was selling loss leaders, and the almost nonexistent profit would not justify buying the additional molds required to make the project economical. So you ask, couldn't the same basic system work for a full-size pool table? I suppose it would—but in 1964 it was all we could do to find a machine that could swing this mold.

But we soon came up with a winner: the original "Step-N-Slide" (Figure 13). And the result proved so successful that it very quickly attracted a number of imitators.

We got a little carried away with the slide idea. The little two-piece mountain (Figure 14) never created much of an avalanche in spite of two-piece nestability for higher-density shipping. But that discouraged us not at all. We forged ahead with a real "heavy bomber" (Figure 15): four identical helical modules on

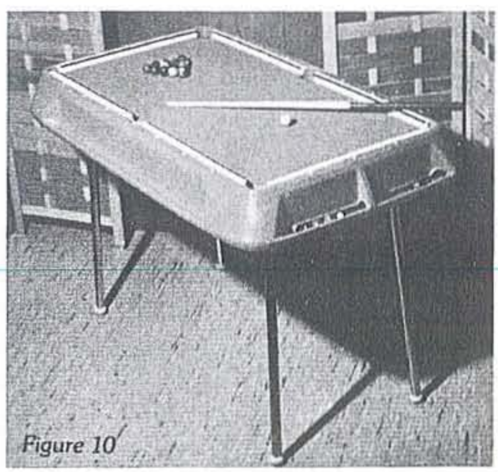


Figure 10

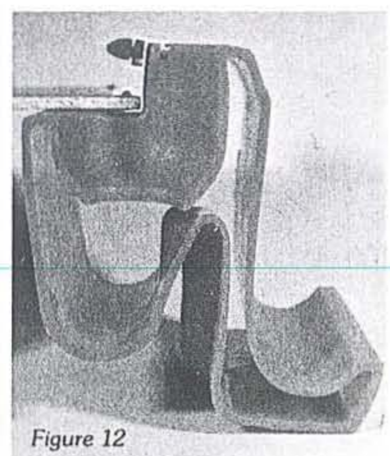


Figure 12

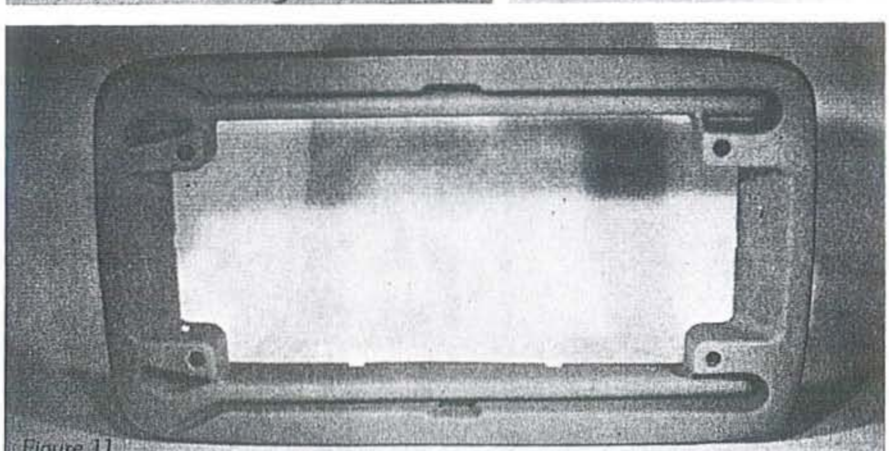


Figure 11

a tubular frame. Believe it or not, we sold a thousand or so of these things through a catalog deal in December of 1968 at $149. Today, that'd be about $250.

The ball (also Figure 15) was another little rotational molding experiment. A major problem we hadn't counted on was that a number of these slides ended up at poolside. The first trip down on the wet polyethylene usually sent the sliders into orbit at about half-turn and they usually never got back to the water. However, we were able to take two modules and create a less spectacular version.

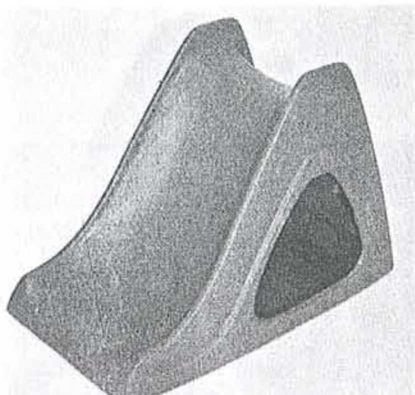


Figure 13

I never have gotten fed up with sliding. (Remember, some of these things kind of get in your blood.) In fact, one of my recent items may end up in a dead heat with the "Swivit" for my favorite design title. I like the "Nautilus" (Figure 16) not only because it seems to be catching on well in the high-price institutional market, but because the design-to-production process went unusually quickly and smoothly.

As is often the case, the concept started with a little time-killing thumbnail sketch. With the help of my 9-year-old daughter, we quickly translated this into a one-fourth-scale plasticene model. When I felt the design was sufficiently cleaned up, I packed the model and visited my friends at Learning Products to whom I'd already licensed a number of items. They liked it. Next step was to study for optimum size and proportion.

As you know, a 10 percent increase in lineal scale means about a 20 percent increase in weight at the same wall thickness and approximately 33 percent increase in shipping volume. Something for designers to keep in mind.

To squeeze the most product into the smallest carton, we "squared off" the design to fill the corners a bit (Figure 17). Through all this we kept in mind the kind of equipment the slide would be run on so we could introduce that optimum size into our factoring.

Having included all the variables and finalized the design as much as we could to that point, we ordered our pattern. The design function was not yet finished, as the real final shaping is worked out with the pattern-maker right on the master.

On a product such as this, we do a lot of test-flying in the shop and make changes as indicated. By working this way, the designer is relieved of the bulk of the sectional detailing he might otherwise have to do, and the pattern-maker is relieved of the tedious chore of wading through prints and having to translate dozens of dimensions from difficult contours.

I think the finished product is a worthy addition to the rotationally molded items of our design already included in the Learning Products line—certainly we've come a long way from that first "Swivit". DDF

Figure 16

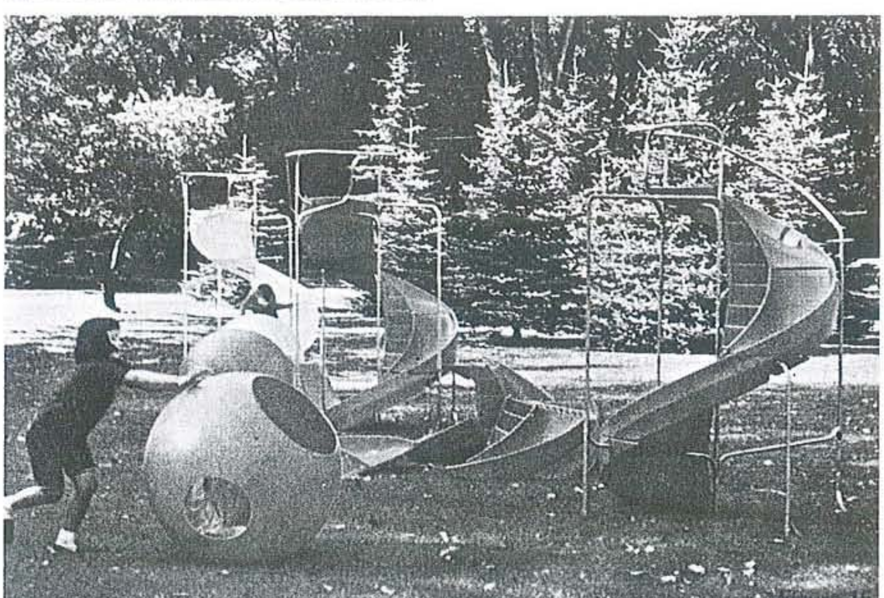


Figure 15

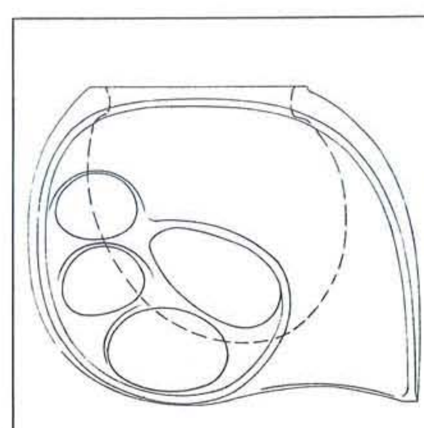


Figure 17