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A Scary Show

Every year investors, economists, industrial planners ... and automotive writers are asked to weigh a staggering number of factors and variables in gauging which industries will gain and which will shrink. And for the first time, there is a new imponderable of overwhelming importance to consider ... how much fuel each industry will be allocated.

There is no doubt that there is virtually a consensus among economists that the U.S. boom will not only taper off this year, but the possibility of an outright recession is growing stronger by the day. If you study the statistics and the mood of the consumer, one is caught in a spell of continual, mounting anxiety.

Detroit is already filled with troubling insights. The industry's top executives have already pegged a decline in sales ranging from 10 to 12 percent. Sales are already 12 percent below a year ago. All the automakers have ordered "temporary" shutdowns in some plants. The number could reach as high as 30, idling hundreds of thousands of workers.

Other than the belated and hastily prepared ban on weekend gasoline sales, the allocation of fuel to heat factories and run machinery, as well as the serious shortage of materials, and the very real and frightening possibility of gasoline rationing, there are other factors that could make for a scary show.

Consumer income is growing at a slower rate and consumer debt is already at a high level. Automobiles and income are closely tied to each other. If income after taxes rises, registrations rise. And registrations have been very high for the last three years in relation to income.

The cost of living, with particular reference to the high cost of food, has shaken the consumer's confidence and reduced the income left for the purchase of other things, including cars.

The additional hardware on board the '74 models for safety devices and pollution control has not only raised prices but increased fuel consumption. Many buyers have opted for '73 cars in a bid to avoid those higher prices and reduced efficiency.

Isolating all the meaningful factors in the tangled web of business and governmental relationships is no easy task. But one thing I can promise: this year, the automotive industry will no longer be literally and figuratively hit. In a sense, it will have to rediscover itself.
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Cover

It takes a visionary to see what 1974 holds for the automobile.

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The First Family of Engineering Plastics
The 10,000-In-One-Shot Brakes

The National Highway Traffic Safety Administration (NHTSA) has mandated heavy-duty brakes for all cars sold in this country. These brake systems will be just dandy for the one in possibly 10,000 motorists who like to race down a mountain-side at high speed ten times in succession or those who get their kicks out of making a series of 100 mph (161 kmh) panic stops.

But for the great mass of American auto drivers, these new "improved" hydraulic brakes are going to mean an additional $50 to $100 in cost, extra fuel-consuming weight and probably less safe braking in many situations. The total bill will be between $500 million and $1 billion a year.

The auto companies are not complaining too much about this brake standard now. For one thing, it is possible to meet this standard. Also, it's a vast improvement over the original proposed standard that was modified after Detroit protested. And the auto companies dislike protesting about every standard.

Basically, NHTSA's '76 braking standard requires all cars be able to stop within prescribed distances in a braking schedule consisting of 11 demanding tests.

These tests consist of (1) repeated stops at 30 and 60 mph (48 and 97 kmh) with a full load, (2) a second series of stops at 30, 60, and 80 mph (48, 97, and 129 kmh), (3) a parking brake test, (4) a third test at 60 mph (97 kmh) with two passengers, (5) a test in which only rear brakes are operating, (6) a braking test with engine turned off, (7) a test in which the brakes are heated up to a point just short of fade, (8) another fade test, (9) a fourth test in which the car is stopped in the shortest possible distance, (10) a test in which the brakes are soaked in water and then tested to insure they recover enough braking ability, and (11) a final "coupe de grace" test in which the vehicle makes 10 "spike" stops at 30 mph (48 kmh) with the driver banging the brakes until he slides all four wheels.

Aked what's wrong with brakes that pass these tests, Howard Freers, chief car engineer for Ford Motor Co., said "They're for the one in many thousands of situations where a guy will really exercise his brakes to the extent that a tremendous amount of performance is required. The average customer around town or on the highway is not even going to notice differences. He's just going to be carrying more weight and more money in the car.

But you do have more brake capacity. As for the average customer, he's not going to know he's got any better brakes. You might be able to come down a mountain ten times in succession and not have any particular problem. But you don't do that very often."

According to Freers, these higher-capacity front and rear brakes will call for much higher brake pressures which in turn will require more hydraulic boosters. Also required in most cases will be larger and more expensive brake linings, and many heavier cars can only meet the standard with four-wheel disc brakes.

Many brake engineers feel even stronger about the '76 brake standard than Freers does. But because auto brakes are still sort of a "black art," rather than a science, these engineers had difficulty in marshalling their objectives in layman's language.

A major problem is that the braking performance of a set of automobile brakes is very dependent on how they have been used previously.

Another major problem with this regulation is that it is entirely based on certain stopping distances but the test drivers are not allowed to lock their brakes, except at speeds under 10 mph (16 kmh). This is another case in which the performance and ability required of the test drivers who meet the standard are vastly different than the performance and ability of average motorists.

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The difficulty in forming these luggage compartment door reinforcements is not readily apparent, but unless the steel has good inclusion control there will be a risk of cracks in the area indicated by the pencil. Ultra-Form 80 performed superbly in this application.

Normally, the shock-absorber bracket (left) is made from 3/16-inch lower-strength sheet steel, and the axle cap is formed from 40,000 psi min yield strength sheet. Without adjustments in the tooling we substituted Ultra-Form 80 for both parts. The trials were successful.

The formability of Ultra-Form sheet steel is not significantly related to rolling direction, largely because of inclusion control and fine grain size. That means you can form difficult parts like those shown without being concerned over directionality of the sheet's properties.

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The voluntary compliance plan to decrease the demand for fuel is not working as well as hoped, but well enough to create second thoughts on the necessity for the rationing of gasoline.

At the end of November, President Nixon commended the American public on the 15% decline in the demand for gasoline, 7.3 million barrels below expectations. But in the first week of December, demand was only 1% below the official forecast, at 47.2 million barrels. The statistic must present some trouble to William Simon, the new energy czar, and head of the Federal Energy Office, because the voluntary closing of gasoline stations on Sundays began on December 1. The thought that must arise is that the voluntary system is not enough to lower the demand to the levels required.

However, government officials point out that the statistics are not from the retail level, but are measures of outflows from primary stocks at depots and refineries. No statistics are kept on the flow from the gas pumps.

Also, FEO spokesmen say that conclusions are hazardous because of the fluctuations which normally occur at terminals. Simon noted in a TV interview that a study of demand figures for a longer period of time might be needed "to get a better handle on how we are doing." Though he did not come out and say it, such a statement may point to a delay in a final decision on a complete rationing program.

The official schedule from Simon has President Nixon announcing the rationing decision on the date of this publication.

Among the Western industrial countries, and in Japan, the energy crisis has had a uniformly depressing effect on automotive production, exports and sales.

An American-based Toyota executive admitted that Toyota had lost over 200,000 units from its Japanese assembly lines due to material shortages related to petroleum shortages. American dealers are continually screaming to the New York and California offices of Toyota in search for more vehicles. Only on the face of it, then, is the small car binge a plus for foreign makers of economy models.

German automakers have been particularly hard hit by the Arab oil embargo. Germany depends on Arab oil for about 60-65% of its total consumption. The sales decrease in W. Germany is expected to pass 50% this month. Opel has reported putting 65% of its work force on shorter work schedules for at least several weeks.

In the U.S., some "furloughs" have already become at least semi-permanent. Ford has permanently laid off 6500 of the 27,000 workers given time off early last month, and Chrysler has decided not to call back about 2600 of the 39,000 employees to be idled the first several weeks of this month. Most of these workers are said to have been hired during the days of dizzying demand late in the '73 model year.

The projected 14% increase in capital spending for plant and equipment is one of the few positive signs for the economy in 1974. If price controls are removed, the First National City Bank, New York, says, higher profits would help justify plans to increase capacity. If planners rethink their spending because of doubts over material availability and fuel access, shortages could keep recurring through most of the decade. In actuality, to lend a bit of negativism to the situation, the bank points out that 5-7% of the increase in outlays represents higher costs. New investment in manufacturing, the Bank says, "may not have kept pace with the demands of the economy," and a 9% "real" growth in spending may not fix the situation.
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AUTOMOTIVE INDUSTRIES, January 1, 1974
Automotive News

A Step Back-In Right Direction

By Richard J. Foodick
Detroit News Editor

In a step heralded by many as another step toward abandonment of all price controls, the Cost of Living Council (CLC) released the automotive industry from wage and price controls in exchange for promises of restraint from three of the Big Four.

Ford Motor Co., General Motors Corp. and American Motors Corp. agreed to limit small car price increases to $150 at retail. Ford and GM said they would limit wholesale price increases on all models to $150. AMC agreed to hold that amount to $100 a vehicle. All three agreed to refrain from further increases for the rest of the '74 model year, "unless forced to by unforeseen major economic events."

What would constitute a "major economic event" was left open, and Chrysler explained that for this reason the company would not agree to the conditions. Chrysler had, a few days earlier, won some court backing in its battle with the CLC over postponement of an earlier price increase request.

The CLC indicated it went along with the decontrolling of the automotive industry even without Chrysler's agreement to the conditions, since the "dramatic" shift in the marketplace caused the company to re-examine the behavior on the part of Chrysler.

Industry reaction in general indicated the move by the CLC was a step in the right direction, but most automakers pointed out that the agreed-upon figures fall short of providing the price relief the industry deserves.

"General Motors is gratified to receive the price increase it requested and welcomes the decontrolling action as a long awaited step toward a return to a competitive economy and to the self-regulating discipline of a free marketplace," said Richard C. Gerstenberg, GM's chairman.

But Gerstenberg noted that documented cost increases justify an increase of $208, not the $150 allowed under the agreement with CLC.

"Accordingly, General Motors will continue to absorb a substantial portion of the increases in costs which we have experienced," he lamented.

Ford, first to release a revised car-by-car price list, added an even $150 to the price of each of its small cars, except the new Mustang II, the price of which was not increased. Other lines averaged a $150 boost at retail, for an average increase of $150 for the entire Ford passenger car lineup. Prices of fast-selling light trucks climbed sharply, with increases ranging from $156 to $303.

Chrysler also indicated it would limit full-size car price increases to a $192 retail boost.

The decontrol of the automotive industry comes at a valuable time. Sales of big cars are faltering as consumers ponder the effects of the energy problems, and automotive stocks have nose-dived along with consumer confidence. The higher prices should rebuild some confidence in the auto industry, which should help the industry concentrate on aligning itself with the marketplace.

Indeed, CLC's Dunlop explained that the impact of the energy crisis was among the factors considered by the CLC in its decision. He noted the sudden shift to small cars in the marketplace, and the avalanche of layoffs by the automakers.

"Granting controls exemptions to the automobile industry will provide maximum flexibility and incentive to speed the shift to production of small cars in the coming year, thereby lessening the impact of the energy crisis on the economy and, in particular, on auto industry employment," Dunlop commented hopefully in announcing the CLC decision.
A Prod For Better Gas Mileage

Donald A. Colburn
Washington Editor

Prodded by the impending gasoline shortage, Congress is getting into the business of regulating automotive gas mileage.

As part of its pre-holiday flurry of activity on energy matters, the Senate passed overwhelmingly a bill mandating at least a 50% improvement in average automobile gas mileage by 1984. A similar proposal was pending in the House, with passage likely, perhaps before adjournment.

The fuel economy measure, an amended version of a bill introduced last May by Sen. Ernest Hollings (D-SC), was part of an omnibus energy conservation bill put together by a group of senators led by Henry Jackson (D-WA).

Among other things, the bill would require the Secretary of Transportation to set an industry-wide fuel economy standard for all 1976 models, e.g., 18 mpg (5.5 km/l). Thereafter, DOT would establish whatever additional standards are necessary to reach the goal of 50% better mileage in 1984 models over '74.

Cars that fail to meet the standard, based on a test by the Environmental Protection Agency, would be banned from the marketplace. The test, however, may be based instead on work that the Southwest Research Institute is doing for DOT.

In a grant from DOT, the institute is seeking ways to lower gas use by improved engineering and at the same time is examining alternate procedures for certification of vehicle mileage.

Since current models average about 13.5 mpg (5.2 km/l), the bill effectively mandates a goal of about 20 mpg (8.5 km/l) for all cars in years from now. Trucks and heavy vehicles are exempt.

The 1978 standards would be due within 18 months of enactment, but DOT is directed first to analyze the interrelationships among fuel economy, safety, reliability, damageability, materials and costs in motor vehicle manufacturing.

The domestic manufacturers worked closely with the Senate Commerce Committee in drafting the bill, and Detroit indicated it could live with the Senate version.

As one spokesman for the Motor Vehicle Manufacturers Association said: "Knowing that something was going to be passed, we went for the least objectionable proposal. The Senate-passed bill is the least of the possible evils that could have fallen on us."

Sponsors of the bill stressed during debate that DOT would have great flexibility in setting the standards, and the automakers would have a full decade of leadtime in which to achieve 50% fuel economy improvement. This, they emphasized, is in contrast to the Clean Air Act of 1970, which set rigid standards and imposed strict exhaust emissions standards.

Before approving the Energy Conservation Bill, the Senate added side amendments to shorten the 10-year horizon and to impose a manufacturer's tax on vehicles getting less than 20 mpg (8.5 km/l) by mid-1975.

Many government and industry sources seemed confident that manufacturers would have no trouble complying with the Senate bill if it were adopted.

In fact, a recent Treasury Department study suggests that the automakers "can produce large cars which yield close to 20 mpg (8.5 km/l) using a stirling technology without sacrificing comfort, styling, or exhaust emission standards."

Some of the mileage aids already available, according to the Senate report on the bill, include: less-lean burn, optimized transmission, combinations, turbo-charged engines, reduced aerodynamic drag, and use of lower-weight materials.

The bill directs the government to maximize gas mileage, subject only to the limitations of technological and economic feasibility. Thus, if new technology becomes available, permitting even greater fuel economy gains by 1984, DOT could upgrade the standards accordingly. This would be done through normal rule-making procedures, with at least 18 months notice to automakers.

Ford Puts 2nd Firm Under a Stirling Pact


That agreement launched a 3-year development program as part of a 5-year plan. Now, a year and a half later, Ford has signed another agreement, with a different firm which indicates the Stirling engine still occupies a significant place in the automaker's drawing boards.

The latest agreement is between Ford and United Stirling AB & CO. Malmö, Sweden. Ford says United Stirling has been developing Stirling engines for the U.S. automaker since June of 1972, and is installing engines in Pinto vehicles for testing by Ford.

So far, however, Ford's relationship with United Stirling has not involved extensive exchange of technical information, according to Jack D. Collins, executive director-engine research Ford's Product Plan...
Goodyear's Single-Belt Venture

By Richard J. Foadick
Detroit News Editor

One "serpentine" belt could handle all the accessory drives on a modern V-8 engine, instead of the average three belts needed with today's V-belt systems, according to Goodyear Tire and Rubber Co.

The "serpentine" belt system developed by power transmission engineers at Goodyear's Lincoln, NB facility uses a one-in. (25.4 mm) wide, eight-ft (2.43 m) long Pol-V belt driving off both sides as it winds its way around the appropriate pulleys.

The Pol-V belt consists of, in effect, six tiny V-belts assembled side-by-side with a single backing. The belt is nearly twice as wide as a conventional V-belt, but not as thick. Thickness, combined with proper materials, allows it to flex and drive from both sides without excessive heat build-up.

A key feature of the system demonstrated by Goodyear is an idler pulley which applies constant pressure to the belt, thus eliminating the need for tension adjustments. A special tool relieves pressure from the idler pulley, allowing easy belt replacement. A possible future refinement would provide for a sensor which would detect any unusual pulley movement, alerting the driver to a problem.

According to Wendell Minor, Goodyear vice president of OEM sales, reaction from Detroit to the serpentine belt system ranges from "keen interest to outright enthusiasm."

Advantages to the automaker include, according to Minor, easy installation, reduction of pulley, drive belt, pulley alignment, fan belt, and longer belt life. Minor also notes that the initial Pol-V belt would be higher than total cost of three V-belts, but says his estimates indicate that this cost would be offset by the savings in assembly line procedures, and the benefits of space and weight savings.

Minor said the wider-thin belt would trim an inch (2.54 cm) from overall engine length and could save up to 10% in belt and pulley weight. He added that a changeover to the system on some Detroit models could be very close.

An obvious question concerning a single belt drive involves belt failure. If that one belt should break, it would shut down the vehicle. With a conventional system, the vehicle could still be driven with broken belts as long as the fan belt was intact.

Goodyear's Minor points out that if the fan belt fails in a conventional system, you're stalled anyway. In addition, he notes that in a properly engineered Pol-V belt system, belt failure could become a thing of the past. With the addition of a rib or two to the belt, engineers could design a lifetime system, he maintains. Minor also notes that the simplicity of belt replacement with the serpentine system would allow a mechanic to carry a spare and replace it on the road if necessary.

GM's Urban Transit Goes Under One Roof

General Motors Corp. decided recently to unite its efforts in mass transportation. It established a new division called GM Transportation Systems Div. to be quartered at the GM Tech Center in Warren, MI.

"This new operating division will coordinate, intensify, and enlarge GM's activities in urban and public mass transportation systems," GM's chairman, Richard C. Gerstenberg, said.

The new division will bring under one roof the personnel who have been engaged in mass transit work from the Transportation Systems Department of the Engineering Staff, certain Research Staff employees engaged in urban transportation research.

Donald J. Atwood, now manager of the Indianapolis operations of Detroit Diesel Div., will be general manager of the new division.

The Transportation Systems Div. will be working closely with GMC Truck & Coach and Electro-Motive.

Gerstenberg said, "The need and usefulness of balanced transportation systems has been increasingly recognized in recent years, and the economic and social pressure for more diversified, decentralized systems are now widely evident in the United States and blent elsewhere in the world."
The petrochemical industry, after months of struggling for recognition in Administration fuel allocation plans, finally saw its efforts rewarded. But, what exactly was won is unclear.

Essentially, the degree of available feedstocks to plastic producers will depend on the size of the pool made available through the allocation scheme that finally is enforced. "It's a very confusing affair," said one petrochemical company spokesman. "We haven't pinned down yet what will be made available to us."

William Simon, the new chief of the Federal Energy Office, announced the proposals for comment. Perhaps the most important, to motorists, refiners and their customers, is the decision to require refiners to further cut back gasoline production. They had already been asked to cut gas production 15% so the crude oil could be used for heating oil.

Initially, the amount of the cut back caused confusion, because of a typo. When it was clarified, the dip was 5%, not 25%. Overall, however, there will be 15% less gasoline available the first quarter than last year. This shortfall is expected to increase by perhaps 10% by the second quarter, it is reported.

The proposed rule sets up different allocation schedules for different feedstocks. For instance, petrochemical companies will receive a 90% allocation, based on a 1972 base period. Naptha and propylene will be made available at 120% of the base period. If demand exceeds supply, reductions will be made on a pro-rated basis.

Meanwhile, the government stance on rationing has been changing. When John Love left his energy chief post, it was reported his strong stance in favor of rationing had put him in bad graces. But recently, William Simon, who replaced Love as chief energy policy maker, indicated that President Nixon will make a decision by the end of the year on whether or not to ration gasoline at the retail level.

There were conflicting reports on the future of gasoline pricing. One newspaper account quoted an FEO informant that gasoline could climb to 90c per gallon. It was also reported that increased costs at the refinery level were being passed on to the consumer. Simon, however, pointed out that gasoline, as a price controlled commodity, cannot rise in price officially before Apr. 30, when present regulations expire.

Reports that the government is continuing to examine the rationing expedient followed closely an optimistic statement from Herbert Stein, chairman of the Council of Economic Advisors. He told a Senate Committee that the government had revised its shortfall prediction downward. But he, too, raised the spectre of rising fuel costs.

UAW's GM Contract Gets Strong Approval

Following an unsettling rejection of its Ford pact by skilled tradesmen, United Auto Workers union leaders received a resounding vote of confidence on the General Motors Corp. agreement by rank-and-file workers.

"We believe that never before in the history of the union's negotiations with GM has every unit voted to ratify a new national agreement," UAW president Leonard Woodcock said.

According to UAW sources, 90.1% of those voting ratified the contract covering 400,000 workers. Skilled tradesmen, had, also for the first time in UAW history, rejected the Ford Motor Co. contract. But at GM, 80% of the tradesmen voted in favor of ratification. In four units, however, skilled tradesmen voted against ratification.

When their votes were combined with those of production workers, the majority vote came out in favor of ratification.
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AUTOMOTIVE INDUSTRIES, January 1, 1974
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Energy is the matter of the moment in Washington, just as it is across the nation. This has added a new dimension to the controversy over the Clean Air Act.

To listen to the debate, you'd think that the crucial thing about emission controls is not how much exhaust comes out of an automobile engine but how much fuel goes in. Miles per gallon seemingly has replaced grams per mile as the crucial statistic for smog controls.

Some of the automakers, along with the oil industry and the White House, are renewing their pleas for extended deadlines or weakened standards for emission control. The Senate Public Works Committee, under heavy pressure from these interests, has voted to maintain the interim 1975 standards in effect for an extra year instead of tightening them slightly in 1976. That vote, by an 11-3 margin, marks the first move by Congress to alter the timetable of the Clean Air Amendments of 1970. Ford and General Motors gave it qualified praise; Chrysler wanted more.

Meanwhile, on the other side of Capitol Hill, a House subcommittee chaired by Rep. Paul Rogers (D-FL) is also considering changes in the Clean Air Act. The White House sent to the panel a plan to go a step beyond the Senate Committee and freeze the standards at 1975 levels for three years.

Strangely, the White House did not discuss its proposal for the rollback with the EPA, which is charged with setting and enforcing emission standards.

If that sounds like a lack of communication in the Nixon Administration, it is. But then all this happened the same day "energy czar" John Love resigned when his more important duties had been transferred to a new Cabinet-level Federal Energy Administration. On the same day, Rosemary Woods admitted again that she had no explanation why her five-minute goof erased 18 minutes of a crucial tape recording. And hardly by coincidence, a poll showed that three times as many citizens trusted garbage collectors as trusted government officials.

One reason the White House bypassed EPA showed up when the agency's administrator, Russell Train, testified before the Rogers subcommittee. Train said he "strongly disagreed" with the White House proposal and recommended that "no changes" be made in post-1975 emission deadlines at this time.

There are two opposing lines of reasoning in the dispute over emission controls and fuel economy. The oil industry argues that use of catalytic converters to meet the 1975-76 standards will squander fuel resources because production of unleaded gasoline required by catalysts is less efficient.

Not so, says EPA. According to administrator Train, the sales-weighted average fuel penalty due in emission controls on 1975 models was 10% and will be less this year because of the market trend toward smaller cars. And he says, 1975 models, many equipped with catalysts, will show an improvement in gas mileage more than offsetting the loss of extra crude oil in production of lead-free gasoline.

GM, which expects to use catalysts on most models next year, has testified that its 1975 vehicles will achieve an average fuel economy gain of 135. The other automakers have indicated that they can achieve more modest gains.

Fuel economy, particularly in these times of petroleum shortage, is a valid concern. But alone it is hardly reason to delay emission control deadlines just when it appears that the automakers have begun to turn fuel penalties into fuel gains.

Emission controls are not the only, nor even the most significant factor in declining gas mileage. Statistics show that of the huge increase in automobile energy consumption over the last 20 years, 90% is due to greater auto use and 10% to decreases in vehicle fuel economy.

Transportation controls, use of radial tires, phased weight reductions, limits on air conditioning and other power accessories offer ways of curbing gasoline consumption without stalling progress toward cleaner air. Congress is considering all of these.

While the oil industry, some automakers, and the White House hope to use the energy crunch as leverage to further delay emission control deadlines, both Congress and EPA have indicated they will move cautiously in tinkering with the Clean Air Amendments.
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Integral unit saves pounds and dollars. Only LEXAN resin combines lens optics with high impact strength. So only LEXAN resin can replace die-cast zinc and acrylic. And turn a heavy fender extension and fragile lens into one light, durable, corrosion resistant unit. Besides cutting costs, this unitized construction saved as much as nine pounds per car.

Capsule design drops overall costs. Small, low-cost, trouble-free lamps required by compact cars are a reality. Lens and housing, each molded in LEXAN resin, are ultrasonically bonded. Screws, gaskets and assembly are eliminated. And a twist-in socket facilitates bulb replacement in this small-envelope grille-mounted lamp. And the unit weighs 60% less than acrylic/gasket/die cast construction.

Bumper placement without great risks. LEXAN resin withstands bumper shock with regard to federal impact requirements. So it offers lamp placement freedom. Which is why this capsule back-up lamp is easily mounted right into the bumper, eliminating costly body seals. And since LEXAN resin has high heat resistance, the entire unit is only a cool "Fs" thin.

Tough studs lower mounting costs. Here, ultrasonic bonding of the housing and lens, each molded in LEXAN resin, provides the hermetic seal. The housing's molded-in rear studs are inexpensively secured with PALNUT* fasteners and the resin's high impact strength drastically cuts stud, lens or housing assembly line breakage.
Wrap-around designs without vulnerability. Acrylic makes wrap-arounds extremely vulnerable. But the design is ideal for LEXAN resin's high impact strength. Although this lens is large and combines sidemarker, back-up and taillight lenses in one unit, it weighs only eight ounces. That's because LEXAN resin doesn't have to be thick to be tough and heat-resistant.

Four lamp functions joined in a stylized wrap-around. It's a front park and turn lamp, cornering lamp, side reflex and sidemarker. And because of LEXAN resin's impact and heat resistance, it's multi-functional yet compact and can take vulnerable placement. So it saves money in overall lamp costs, assembly line costs and inventory costs.

Snap-fits lower attachment costs. Since labor usually ends up costing more than material, LEXAN resin is economical even in uncomplicated concepts, in bumper-mounted reflectors, for instance. Screws and screw mounting were eliminated because, unlike acrylic, LEXAN resin's strength withstands snap-fitting without snapping. And like any lens or housing of LEXAN resin, costly touch-up oven masking is not needed.

Brightwork without costly plating. Here, LEXAN resin's unique combination of clarity, weatherability, toughness and heat resistance allows integration of brightwork and housing via second-surface vacuum metallizing that lasts. The resin's impact strength permits molded-in mounting studs. And in addition to reducing costs, this concept can drop weight a whopping 80% over die-cast zinc.

As you can see, LEXAN resin cuts costs and weight without sacrificing design for savings. In fact, it opens up a whole new world in lamp design. So before you put pencil to pad, let our automotive technical team contribute to your initial design thoughts. Write to Automotive Manager, Plastic Dept., General Electric Company, One Plastics Ave., Pittsfield, Mass. 01201. Or call the GE Plastics Center, Detroit, (313) 355-4460.
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A LOOK INTO the automotive future with Edward Cole, the very enthusiastic and influential president of General Motors, is a sort of Pandora's box of new opportunities.

Sometimes called GM's "chief engineer," Cole truly has been sort of the "world's chief automotive engineer." In recent years he pushed for air bags, rotary engines, catalytic converters and low compression engines burning unleaded fuel.

Looking at the future of the auto industry, he said, "Our business is going to get more technically-oriented. The government is going to get more technically-oriented. I think you're going to see a change from the lawyer-type to the engineer-lawyer-type in business and government.

With energy and natural resource problems, we'll probably have greater opportunity to bring new things to market. You never know until you work on a problem what you can do.

One of the things that has always bothered me is how to stimulate the young engineer. I think we're going to need a lot more innovations and new ideas. The company that stimulates thinking of young engineers to demands of the economy in line with material problems is the one that's going to emerge on top.

As to the long-range future of the auto market, he said, "The growth will probably be underneath (the big cars). "How far underneath?" is the question. What people regard as safe transportation and how it intermingles with other traffic are some of the problems. I think there is a real need to do everything we can to conserve energy.

Regarding chances for a "mini-mini-car" succeeding in the U.S., Cole said present safety features and those mandated for the future make it unlikely that a tiny car could meet the government's injury severity indices.

He explained, "If you have a severity index for the chest or head at say 30 mph (48 km/h) into a barrier, you've got to have space to slow down. As the car gets smaller, it has to be stiffer and the load to slow down is higher. Something's got to give—it's space.

When asked about the possible impact of gasoline rationing on auto sales, he predicted that it wouldn't have any effect since people will automatically discipline themselves to do just a little less unnecessary driving.

Regarding the possible effects of dollar-a-gallon gasoline, Cole commented, "I think the real way to control is through supply and demand. This is the free enterprise system and that's the way it ought to be. Gasoline is bearing a large tax burden right now for a lot of things."

Concerning public reaction to the 1974 cars and their starter-belt interlock systems, he said, "Generally the inputs that we've got have been unfavorable in the field. But it hasn't gotten to the point where someone has refused to accept a car because of the interlock system. That's where the 'punch point' comes.
Continuing on passenger-restraints, Cole said that General Motors would offer inflatable air bags as options for the 1974 and 1975 models.

However, he asserted, "The plan for '76 is unclear because of court action to regard to the test device or dummy. As yet, the government hasn't clarified what they're going to do for '76."

Many auto officials feel the "air-bag ball game" has changed fundamentally because it lost its "passivity" with GM's decision to install lap belts along with them.

Cole asserted, "You don't have to have the belt. We call it a 'delete option.' There's a little problem, we think, from the legal point of view, if a person wants a belt and it's not there. Or he gets injured and thought maybe he wouldn't have if he had used a belt."

"There might be some concern, particularly in a roll-over. A bag doesn't do much in a roll-over. We don't even deploy it. Nor do we deploy it on side impact. Both of these are low-level of incident, and low-level of injury."

Because of conflicting goals of the National Highway Traffic Safety Administration for safer cars and the Environmental Protection Agency's pressure for more economy, Cole said that the auto companies are caught in a collision course with these two agencies.

He said he didn't see much indication from Transportation Secretary Claude Brinegar of any back-off on safety standards because of the energy "crunch."

Asserting that the government should revert to lesser requirements, Cole said, "Like bumpers—there's no way the commuter is going to get a cost-benefit from bumpers because of extra fuel consumed—about 1/10th to 2/10th mpg (0.04 to 0.09 km/l).

"They also add considerably more weight than just the bumpers themselves because you need supports. The cars also got longer and take more space because, when you absorb energy without damage, something has got to absorb the energy and it's got to move freely three or four-in (18 or 10 cm) without contacting safety-related items."

Acknowledging that some money is saved on insurance premiums, he said these bumpers still weren't cost-beneficial, adding that his conclusions were based on information from GM's own large insurance affiliate.

"It's very difficult to show much gain with these bumpers," he added: "The problem is that we evaluate them with barriers and pendulums which are ideal. In the real world these things don't mesh just right. There are other obstacles besides cars that are involved. When you take the real world, there isn't the benefit that some people are projecting."

Asked about the new paint systems that would soon be needed by the auto makers because of emissions from today's paints, Cole said that water-based paint is the most promising to GM because it carries the paint pigment without hydrocarbon solvents.

He explained, "Anytime you have hydrocarbon solvents, you must either afterburn or catalytically treat them."

He asserted that water-based paint looks better than powdercoating to GM because that process requires a separate booth for each color, calling for extensive plant additions. GM is experimenting however, at its Framingham, MA assembly plant with powder.

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EXPLOSIVE, UNPRECEDENTED demand for trucks during 1973 strained industry capacity and produced record sales levels far above most prognostications.

Spurred on by a continued demand for light trucks and a real need for medium and heavy-duty trucks to handle the logistics of a booming economy, truck sales hit 3.1 million units for calendar year 1973.

GMC Truck and Coach Div., General Motors Corp. set its share of records. Alex C. Mair, General Motors vice president and general manager of GMC, was able to announce a record year with two months of '73 left on the calendar. GMC's unit sales for the entire year were expected to total 227,000, up 24.3% over 1972.

How does 1974 look to the GM executive? Despite a number of unavoidable "ifs," not bad. Mair says he expects GMC's sales to increase 7 to 8% during 1974. This expected increase above the spectacular 73 sales levels is justified, Mair feels, on the basis of the strength for demand of medium and heavy-duty trucks.

Mair also calls for another three million unit year for the entire truck industry in 1974.

But, he cautions that forecasting assumes adequate fuel supplies to keep trucks rolling. He notes optimistically that President Nixon's speed limit preferences included a higher limit for trucks than cars, indicating the President's awareness of the need to keep commercial goods moving for the sake of the economy.

But energy is also needed to produce materials, both raw and finished. Materials and components shortages have been plaguing truck builders for several months.

Mair terms the parts shortage "very severe," noting serious problems in getting leaf springs, axles and diesel engines. Manufacturing facilities have been hard pressed to keep up with the meteoric rise in truck demand in recent years. In addition, Mair explains, the general shortages of materials in the booming economy of 1973 are superimposed on those peculiar to truck builders. Medium & heavy-duty truck production, due to their large and specialized parts, has been affected most.

The problem is not assembly capacity at GMC, but rather, getting the components to assemble. The expected increase in sales at GMC for '74 is predicated on solving parts supply problems, Mair explains.

"Our biggest concern is to obtain enough components and parts for the medium and heavy-duty areas which will be the portions of the business most significantly advancing," Mair stated.

While predicting a continued strong demand for medium and heavy-duty vehicles, Mair con-
TRUCK PRODUCTION

"I anticipate a relatively dramatic increase in business as the worldwide market for automobiles and trucks increases. The need for supplying vehicles to other parts of the world exists more strongly now than it has in the past.

cedes there is a "potential" problem in the light-duty truck and recreational vehicle markets. These areas are more elastic in demand, he notes, and hence more subject to the effects of energy questions, than are medium and heavy-duty trucks. The larger vehicles, he explains, are purchased because the buyers need them, not just want them.

STANDARDIZATION WELCOMED

The GMC general manager said he would welcome more standardization of components, in order to simplify the "very complicated" truck business. In spite of continuous pursuit of simplification, "we have only been moderately successful at it," Mair comments.

"I believe that materials shortages in our country and the world will force us into doing an even better job at standardizing certain elements," he contends.

Shortages have also caused GMC to look outside the United States, to Japan, Mexico, and Spain, for some of the components unavailable in the U.S.

So far, GMC sales have been concentrated primarily in the United States and Canada, with very few sales outside these areas. But Mair isn't writing-off the rest of the world.

"I anticipate a relatively dramatic increase in the worldwide market for automobiles and trucks increases. Even at a faster rate than it is increasing in the United States. The need for supplying vehicles to other parts of the world exists more strongly now than it has in the past," Mair notes.

How about the general business outlook?

"If we really work at managing our energy, we should not have a dramatic slowdown, we should have a leveling-off of our business," Mair contends. He explained that some aspects of the energy crisis could actually be beneficial to the economy in the long run, by eliminating waste.

"We probably will never be able to get energy as cheaply anymore," Mair comments.

The government should concentrate on eliminating wasteful aspects of fuel usage. Mair contends. He feels there are "tremendous reserves" of fuel in what is now wasted.

Concern over fuel conservation should give mass transit a boost. The bus requirements in the United States "are bound to increase drastically" when people are limited in the use of their vehicles, Mair explains. But GMC is "parts limited" in this area too, he laments.

Commenting on price controls, Mair explains, "I just generally feel that they've been on long enough, and it's time to seriously review or relieve them. Let the natural controls take over for a while.

Is the current truck boom a temporary "peak load" to be waited out by suppliers, or are present levels going to continue, justifying capacity increases on the part of suppliers?

"I think we are going to continue to have this demand. Therefore I feel the suppliers should meet this demand. I would not do it more cautiously than I would have a year ago. But, I wouldn't be cautious enough not to do it," Mair comments.

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AGRICULTURAL EQUIPMENT GOING FLAT-OUT!

By James B. Pond
Midwest Editor

ANY HOPE THAT THE SUPPLY of agricultural and industrial equipment will catch up with demand during 1974 seems to be put down with each new on-rushing crisis. The industry keeps trying.

Stan F. Lancaster, vice president, Marketing, Agriculture/Industrial Equipment, International Harvester Co., Chicago, IL, holds that the industry's suppliers are the key element. Unfortunately, they can be more vulnerable to materials shortages. As a result of heavy reliance on suppliers, it is too soon to predict the effects of the fuel and energy crisis on farm equipment production. In any event, Lancaster sees no advantage gained at this time by trying to increase facilities or labor force to increase production, although most equipment producers including IH, are in the midst of significant expansion programs.

"The big challenge ahead lies in distribution," Lancaster predicted. "Everyone is trying to optimize the product mix," he said, "to get the needed equipment in the right place at the right time. This requires close control of inventories as well as the types of units being built." Lancaster indicated that dealers' inventories are very low.

According to industry statistics, he explained, "148,000 agricultural tractors were sold during the Nov. '72 through Oct. '73 period while only 160,000 tractors were built.

Retail sales of farm wheel tractors reported by the Farm and Industrial Equipment Institute, Chicago, IL, during the Jan.-Sept. '73 period accounted for 148,576 units, an increase of 25% over '72, while industrial wheel tractors at 41,802 units, were 13% higher. But, perhaps more significant, sales of combines were up 47% during this period, at 23,475 units, and corn heads increased 51%. As for IH, fiscal '73 sales of agricultural and industrial equipment, which represent 32% of sales volume, were $1,336 million, an increase of 22%.

The indicator everyone watches to foretell future farm equipment sales is not farm income. This is estimated at $24 billion for '73 and projections for '74 are for a higher gross with a lower net.

EXPLODING MyTHS

A few myths were exploded by Lancaster in describing the farm scene today. Most significantly, he pointed out that the number of large corporation agribusiness farms is declining. "They have backed off," he explained, "as while farms are getting bigger and are incorporated, the vast majority of corporate farms are family held. There is also a trend to small, part-time farms of 10 to 20 acres (4 to 8 ha) near many suburban areas.

The average farmer today likes to be independent and want to have his own equipment. He is
Collins . . . "The demand for agricultural equipment overseas parallels the demand here. Everyone is going flat out!"

better educated than ever and understands such things as cash flow, leverage and the cost of capital. There appears to be an increasing interest in equipment rental and leasing.

INCREASED PRODUCTIVITY

Lancaster credits the amazing increase in farm productivity, reducing the time it takes to produce 100 bushels (3.5 cu m) of corn from 53 hr in 1950 to only 7 hr in '73, to a combination of equipment and technology.

The size of farm tractors has been increasing rapidly. Averages now approach 80 hp. In 1960, average hp was 51 and in 1970 climbed to 73 hp. By contrast, a 60 hp tractor in Europe is considered large today. Lancaster pointed out that the most dramatic change in 1973 was in the 120 hp and over class, accounting for almost 25% of ag tractor sales.

Lancaster believes the superior efficiency of the diesel will mean a plus. He also sees a strong trend toward increasing operator comfort.

REAL GROWTH OVERSEAS

Michael Collins, Agricultural/Industrial Equipment export sales manager for IH Export Co., handles exports of U.S. built machines as well as those produced in IH's overseas manufacturing facilities. In his view, "The demand for agricultural equipment overseas parallels the demand here. Everyone is going flat out!"

"Many believe that tractor exports are hurting domestic shipments to U.S. farmers. In fact, as far as IH is concerned, this is not true. World currency revaluations have placed the U.S. in a more favorable, competitive price situation. This, together with our aggressive marketing and, the trend toward larger, higher production machines, swells order books. Unfortunately, deliveries are protracted and export has to take its turn in line with domestic customers."

Collins said that while tractor design concepts of export machines are similar to those of the U.S., there are a number of requirements necessary to meet local road regulations and customer requirements in export areas.

Farm implements are more complicated and have to take into account the various agricultural practices. For example, in Europe, farmers harvest their wheat crops low and save the straw. U.S. farmers are interested only in the grain.

Many good ideas are developed in Europe and find their way across the Atlantic. Demand for mower-type cutter bars is dropping rapidly and being replaced by the recently introduced drum-type mowers. They are easier to maintain and do a good job. The demand for all-wheel drive tractors is growing in popularity, particularly in Europe where all-wheel drive enables the farmer to get into the field earlier after thaws and remain late in the fall.

HIGHER HP DEMANDED

The demand for higher horsepower is increasing. Farms are getting larger and there is a thirst in Europe for U.S. technology in the fields of high production, hybrid seeds and intensive cultivation. IH produces tractors in Britain, France, Germany, Turkey, Mexico, India, Australia and Japan.

IH is moving towards worldwide design of its entire tractor line to maximize the opportunities for sourcing in various overseas countries.

The long-term outlook for agricultural and industrial equipment worldwide borders on the fantastic. While the U.S. will maintain a dominant position for some time to come, Western Europe, which has the most advanced agriculture outside the U.S., is planting sizable acreages of corn using U.S.-built equipment and short-season hybrids. Southeast Asia is learning how to grow corn, grain sorghum, wheat and soybeans. It may realize two crops a year on the same land in some areas where the climate and rainfall are favorable.

Collins believes the eventual breadbasket of the world could well be Africa. That means a whole new ball game for all types of equipment.
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Pontiac decided on aluminum to reduce the weight of the 1974 Firebird's rear bumper system by 35 pounds. Using a reinforcement and mounting brackets made from aluminum extrusions, Pontiac saved the extra weight of a comparable system in steel.

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Evidence of the fuel crisis was visible both inside and out at Eaton's world headquarters in Cleveland, OH. The lights in president Paul A. Miller's office were dimmed, only a small part of a corporate- and world-wide effort to stretch fuel use. "On this floor alone we have reduced 6000 watts, with light bulbs alone," Miller remarked.

Eaton, as a multinational corporation, has worked diligently on the coordination of fuel conservation among all its operations. An idea arrived at in England may also go into operation in Shenandoah, IA. Miller also chairs Eaton's Energy Conservation Committee.

"We are still going ahead with major capital expenditures as one positive sign for 1974's economic health."

COMPONENT PRODUCTION TO INCREASE?

By Carl A. Gottesman
Eastern Editor

MANY FIRMS, INCLUDING EATON, are seeking to put the heat that normally escapes into the atmosphere to work. Heating of water, or process steam, are two definite possibilities, Miller says. "I think this is going to open up a whole new ball-game that could be healthy. It could also turn out to be a cost savings, because people will be looking at alternate means of utilizing what they have been throwing away in the past."

Necessity is again breathing new ideas to more efficient use of what is available. For instance, Eaton is examining the potential of using hot exhaust from turbines to generate steam. Other companies, Miller reports, have already done this. "You extend that to a lot of companies, and there's just a hell of a lot of energy that can be saved."

CONSIDERATIONS IN PLANT LOCATION

The criteria used for new plant locations will more strongly move toward the availability of gas, Miller reports. For the past two or three years, the first thing considered in a new plant's location has been fuel supply. Now, the prevailing uninterruptible contracts aren't "worth the paper they're printed on."

Now, a company must go beyond the supplying power company, to find out the type of transmission being tapped, and who controls the field. "What guarantees do you have on your source?" is the question Miller asks fuel suppliers when considering a new plant location.

He also sees the day, if the situation starts critical, when the government may have to "commandeer" private reserves of natural gas to make certain that supplies are available where they're most needed. A steady-by plan Eaton had drawn up for propane had to be scrapped when government began mandatory allocations. That is only one example of penalties business faces when government steps in.

If the energy crisis, and the search for fuel supplies to run plants is industry's number one concern, then the number one assumption in the automotive industry is that the small car parade has only just begun."
Miller sees the percentage of small cars rising "dramatically," from the present 48% to between 75% and 90% of the total within a year or two. "What effect does that have on our operations, and what options do we have? We are making that study now," Miller announces.

Figures drawn up before the energy shortage became a crisis with the Arabian embargo hadn't been restructured at Eaton, "because nobody has a crystal ball." The decline Eaton saw for passenger cars was between 7% and 9%. "My personal opinion is that it will be down a minimum of 10%.

As automotive downturn, if short-lived, could carry a few blessings, Miller believes. Excess demand has created capacity and material problems for all suppliers. A slack period is needed for a return to equilibrium. Also, he states, the overtime periods required for peak production over two or three months has raised absenteeism during the straight-pay week to 15% in some plants.

**MAJOR EXPENDITURES CONTINUE**

Eaton has not given its expenditure plans for 1974 a rethinking because of the bad news coming from the stock market, or because of new worries over energy, Miller reports. "We are still going ahead with major capital expenditures as one positive vital sign for 1974's economic health. At Eaton in '73, expenditures were up 25% from 1972, totaling more than $70 million. Though Miller could not present totals for '74 spending, he said it will be "a lot higher" than in 1973. This he uses as an example of their basic optimism in the market for products in 1975, '76 and beyond.

One economic indicator that still disturbs Miller is deposits-versus-withdrawals in savings banks. Recently, people have not been saving as much. "I think that is something to be worried about. Sooner or later that negative outflow gets to a point where people won't have the money to spend." This barometer affects passenger car buying, particularly second car buying, and purchases of recreational vehicles. These have already declined in sales.

**WHAT'S MOST ENCOURAGING**

The most encouraging development Miller sees on the international scene is the increasing ease with which American industrial products can now compete in foreign countries. The Common Market has introduced a monopolies commission, much like England's to make it more difficult for acquisitions in the EEC. "They are trying to protect the market that they have and trying to prevent the invasion of foreigners coming into their market and acquiring companies."

The protection of markets will not avoid the sales and production trends that develop in the U.S., Miller contends. "If the U.S. goes into a downturn in automotive production, you can be pretty sure that within a 12-month period the rest of the world, excluding Brazil, will be experiencing a downturn also. They follow us on a downturn like they follow us on an upturn."

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MACHINE TOOL PROSPECTS

ORDERS FOR MACHINE TOOLS—metalcutting and special transfer types—especially—will continue through 1974 at or near industry capacity. Not only for the U.S.A., but worldwide.

That's a conclusion drawn by Ralph E. Cross, vice president of the National Machine Tool Builders' Association, and a recognized international authority, especially on automotive tooling.

Trends to smaller cars and more economical engines are pushing-up orders around the world, and the impact of the energy crisis will accelerate these trends. There's also renewed activity in trucks, off-road equipment, tractors and farm implements. An international market in special machine tools is also developing in these areas.

However, Cross warns, "the increased demand for machine tools in the last 18 months has created an under-capacity condition in the machine tool industry—a situation not likely to change in the near future but one that will ultimately improve for the good of both buyer and seller."

The traditional cyclical nature of the machine tool industry conditions builders to hold the size of their organizations somewhat below capacity needed for supplying the market during peak periods. This fact causes delivery times to stretch out during high demand periods—a characteristic of the market that machine-tool buyers normally anticipate and allow for in their planning. However, they seldom plan for purchase lead times of the extended duration that we see currently shaping up," adds Cross.

Opening of Eastern markets to U.S. machine tool builders for the first time, a new situation in Europe and Japan mean new opportunities. In fact U.S. output in metalcutting and transfer machines could run over $150 million in 1974. But at the same time, these marketing opportunities mean new problems.

"When a prolonged high-demand period arrives such as the one we are presently experiencing," notes Cross, "temporarily industry under-capacity situation becomes relatively permanent and can upset plans of an unwary buyer. Those whose equipment purchase programs are geared to new product introduction deadlines may well find themselves unable to meet these requirements unless they allow for unusually long lead times. During these periods, items that are normally available 'off-the-shelf' might require six months lead time.

"Equipment normally supplied in six months may take 12 months. Large pieces of equipment usually delivered in nine to 12 months will require 15 to 18 months. What's more, this situation is likely to remain this way for some time because the machine tool industry cannot expand overnight. It may very well take two years before any significant increase in capacity can be achieved." How did all this come to be? An unprecedented set of peacetime demand conditions has brought about this situation. Here are the major controlling factors, according to Cross.

Devaluation of the American dollar during recent months has brought about a drastic shift in the ability of domestic machine tool builders to compete in overseas markets. At present, most
U.S. builders can outbid foreign competitors (and their own divisions or subsidiaries) and still maintain normal profit margins.

This situation has the effect of potentially making the U.S. a much heavier exporter of machine tools than we have been in the past. Even though this currency situation primarily affects the capacity of our domestic machine tool market, it will have a profound effect internationally on the price of machine tools. Foreign builders will have to reduce prices to obtain orders. Domestic builders will be able to command higher prices abroad. The net effect—higher prices for U.S. tools—will increase our balance of payments deficit for the U.S.

**U.S. COMPETITIVE POSITION BETTER**

"This improved ability of U.S. companies to compete abroad will also affect other segments of industry. This in turn further intensifies demand for machine tools, particularly for high-production special machines.

Take the truck, tractor, and off-the-road equipment manufacturers for example. With an opportunity to expand overseas sales as a result of their improved competitive position, these companies can achieve production volume levels that will necessitate their purchasing more efficient dies and transfer type machines, further contributing to the machine tool industry under-capacity. This same kind of demand spiral can also be expected from other hard goods manufacturing industries," adds Cross.

"The decision by our government to grant export licenses for the more sophisticated types of machines, such as transfer and large automated systems, has enabled builders to trade with eastern European nations. This has also contributed to the current record backlogs reported by most domestic builders. Although this decision is one cause of under-capacity at this time, it is certain that it will strengthen the U.S. machine tool industry in the future.

"Contrary to what many people think, this move by our government is not one that will have the effect of increasing the industrial strength of western European countries in relation to the U.S. because these countries have been able to purchase all their needs from our foreign competitors. This situation has increased the number and size of our competitors abroad, and has stifled growth in our domestic machine tool industry, while having little or no control effect," explains Cross. "In fact, instead of improving our national security, the old export laws harmed it by inhibiting growth within the machine tool industry—one of our country's strongest defense weapons at times of peril."

"When you add to these new foreign demands the demands on our domestic machine tool industry for new equipment to improve control of engine emissions, plus the new equipment required to produce new engines, you see the major causes of the current situation," notes Cross.

"The energy crisis has created a situation unique in the history of the automotive industry. Overnight a large segment of the industry's production equipment has become obsolete. Gas rationing, higher fuel prices, higher fuel tax or a combination of these effects will make large size automotive engines too expensive for many people to operate. While the overall demand for automobiles may decline, the fuel-saving advantage of smaller engines will significantly increase the demand for smaller cars and new machines to produce them."

"The answer of how to live with these unusual conditions lies in the buyer taking a thorough, investigative approach in planning new equipment purchase plans. A lesson in this regard can be had from recent experience of government, attempting to enforce the original 1975 emission control standard on the automotive industry. At first government took the position that enough capacity existed in the machine tool industry to supply the necessary equipment to produce the new engines designed or alterations required. They needed to focus their concern only upon whether the new engines would perform to expectations."

"However, after close investigation into actual capacity of the machine tool industry, government officials learned that it was virtually impossible to purchase all the equipment required to produce new engines. This discovery proved a contributing factor in EPA's reduced demands on 1975 model cars. It will no doubt influence its attitude on future enforcement of emission laws," states Cross.

"Certainly U.S. machine tool builders will respond to long-term favorable conditions by expanding their organizations, points out Cross. The primary factors limiting quicker expansion are: high cost of money; high cost of construction; scarcity of skilled manpower; and long lead times for purchasing the machines which make the machines."

"Meanwhile, if buyers will stretch out their plans, rather than cancel them, the long-term demand strength will move to spur expansion in the machine tool industry. The results will be eventual improved machine tool lead times, and a healthier U.S. machine tool industry—one that can better supply domestic needs and compete favorably in foreign markets. Both of these factors will contribute to our country's economic and industrial strength in years to come."
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You can't raise the roof off Fruehauf trailers.
CONTINUING SUPPORT FOR front-wheel drive, further applications of Hydragas suspension and a boom in powdered metal components are the outlooks of Austin-Morris Div., British Leyland, according to Harry Webster, director of engineering. On the minus side are strong doubts about the Wankel, and extended use of structural plastics, which could be balked by a long-term oil shortage.

Austin-Morris is the corporation’s high-volume manufacturer. In 1972 they produced 761,000 vehicles to account for 70% of the combined output with 84,000 employees, or half the payroll.

As for the Wankel, Webster says, “We are not satisfied that it is the best way of giving the customer value for the amount of fuel he puts into the vehicle. Every time we have tested one of these engines, our own or others, it has always been expensive on fuel.”

“Why should you make your customer, for a certain size car, burn a lot more fuel than necessary to achieve the same end?”

“True, there are advantages: the Wankel is balanced, smooth and will rev. But, a six-cylinder engine of the same capacity, with modern mountings will give you just as much power for the same smoothness, and with a lot less fuel consumption.”

Production cost is another big factor, he says. “This rotary is a lot more costly to make. If you add up every part, including the seals and the springs behind the seals, it has many more specialized parts than a piston engine, despite what they say about only so many bits going around.

“If something happened which showed that it could be economical, and could fulfill present and future pollution regulations, then British Leyland would draw on its experience with the Wankel and start making it. But we don’t think this is necessary at the moment.”

The energy crisis is a factor in Webster’s thinking, and this also governs his views on the future.
ENGINEERING TRENDS

of petroleum-based plastics. Structural plastics, GRP body components and even plastic-coated steels are not in the cards so long as crude oil is going to be limited.

"Already there are not sufficient plastics to go around. We are extremely worried, and are very busy searching for alternative materials."

Quite aside from the question of availability, he maintains that plastics for structural parts do not figure economically for high-volume production.

"They say the break-even point in numbers on the tooling that you need has gradually gone higher, but it's not like anything near the quantities that we want."

"Painted steel, properly pressed, is still the cheapest way of making car bodies in volume. No doubt about that at all."

OTHER TRENDS IN MATERIALS

Regarding other trends in materials, there is great promise for powdered forgings, Webster feels. There is no question about the advantages for highly-stressed components like connecting rods and bearing caps. The tooling is cheaper, material can be saved, and very little machining is needed.

As for glass, he continues to favor the toughened windshields used on most British and European cars since laminated glass is more costly. "What I say is: bring out a law to make everybody wear a seat belt, and it doesn't matter what damn glass you have got in there, does it? That's what I would do. It is still the safest way."

"But that aside, I can see that if people want this so-called occupant protection when they are not wearing safety belts, they would want the latest laminate."

CHASSIS DESIGN FACTORS

On chassis design, Webster remains a strong adherent of front-wheel drive, despite the fact that this concept was recently dropped by Triumph on the 1500 sedan. This is a relatively low-volume car, and Triumph changed over to an orthodox drive-line to standardize production and reduce costs.

At Austin-Morris, "We are geared into front-drive vehicles, and have no intention of dropping them. I think the secret is in big volume, and will stay that way."

All-independent suspension using Hydragas design is also a firm commitment. This first appeared on the Austin Allegro last spring, and will be applied to other high-volume cars in the future. "We are going ahead with this for all we are worth, and will endeavor to standardize the components as much as possible as the years go by," says Webster.

HYDROLASTIC SUSPENSION

Hydragas is a second-generation derivation of the Hydrolastic suspension introduced by Austin and Morris over ten years ago. It uses nitrogen gas instead of rubber as the springing medium. Aside from the improved ride and handling, it avoids the problem of rubber creep and sag, and aging with use. "And it's both cheaper to make and lighter," Webster stresses.

Unitized bodies with ever-lighter subframes is another continuing pattern for the future. This construction keeps weight to a minimum, and simplifies assembly of the vehicle.

What is the outlook for Austin-Morris car sales in the United States in view of new American sub-compacts like the Mustang II and the success of the Japanese? "We think we are in a fabulous situation to get aboard this bandwagon with the Morris Marina," is Webster's reply.

"It has been accepted beyond our wildest dream, and we are going flat-out to do all we can to maintain it in the American market. The Marina achieves excellent economy, and I think it could be a real winner."

But he doesn't think the Allegro will ever be sold in the U.S. "There is no point in competing with yourself in an overseas market. The Allegro is a more technically sophisticated vehicle, and for the States with its high labor costs I think it is right to stay in the straightforward transport business with a front engine and rear drive."

POLLUTION AND SAFETY COMPLIANCE

Can U.S. pollution and safety regulations be met? "Yes, as far as we know at the moment," he says. "As the years go by we shall meet them, and continue to meet them. For emissions there are catalysts, exhaust reactors, stratified-charge engines—you name it. Whatever becomes necessary in order to meet the regulations, we shall do it."
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Temperature is heating up as a major factor in automotive engines and associated pollution control devices. Stackpole's new packing seal and gasket graphite has a lower inherent reactivity than conventional graphite, is oxidation resistant to both static and high velocity air impingement. With the same inherent lubricity of other carbon and graphite materials, it is resistant to most chemicals and to thermal shock. Extremely flexible in thin form, it can be very rigid in multi-layered structures. Stackfoil can operate normally at temperatures in excess of 1000°F. No wonder people call Stackfoil a hot new material.
"WE ARE VERY ANXIOUS to expand our facilities in Spain...it has the greatest growth potential of any country in Europe." Thus, a British Leyland spokesman sums up the scramble among Europe's big auto makers to get into the booming Spanish car market. From producing 91,320 vehicles in its Spanish factory during 1972, BLM intends to boost production to about 140,000 by 1977.

Other major manufacturers have similar programs. The latest to announce expansion details is Renault. A Renault spokesman said his company would be stepping up production to 340,000 vehicles a year by 1980 doubling present capacity. This would be achieved by building a new factory either in Palencia or Salamanca and enlarging the present plant at Valladolid. The Renault operation in Spain is a joint venture in which the French company has a 50% share in the operating company, Fasa-Renault.

SEAT IS LARGEST CAR MAKER

The largest motor car maker in Spain is Seat, which was started as an assembly plant by Fiat in 1953 with 900 workers. In 1972 it made 338,438 vehicles and plans to raise production to 600,000 units by 1977. It claims to be the eighth largest car company in Europe and intends to maintain its pre-eminent position in the Spanish market.

U.S. makers spotted this market late in the day, but are now making determined efforts to carve out a stake. Ford announced some time ago that by agreement with the Spanish government the company intends investing $290 million for its first Spanish plant and should be building a quarter of a million vehicles by the end of the decade. More recently, GM announced that it may build a new plant in the Seville region.

The background to this vigorous activity is the considerable recent growth in the Spanish economy, accompanied by a marked switch to industrial production. There has been a big expansion of the steel industry. Latest figures show an increase of 15% over 1972.

Spain's emergence as an industrial power has been unobtrusive, but rapid. In the country's Third Development Plan, the annual rate of growth for gross national product envisaged over the next decade is 10%. This means that the country will be doubling its national wealth every eight years.

Rising affluence means more cars. And car sales are rising fast. So fast, that even the market forecasting experts can't keep up. The Third Development Plan expected that new registrations would hit a million a year in 1980. Latest figures show this to be an underestimate. The 900,000 mark should be reached by 1977.

RUSH TO INVEST IS SUBTLE

An explanation for the rush to invest in Spain's automotive expansion is actually more subtle than a simple desire to get a share of a new and rapidly-growing market. New legislation announced recently by the Spanish government, designed to stimulate growth in the motor industry, spells out clearly the conditions under which foreign investors will be permitted to operate under the umbrella of "preferential interest." SPANISH LEGISLATION BIG FACTOR

Conditions vary for companies, depending on whether they were established before or after drafting of the legislation. "Old" companies like Seat, Fasa-Renault and BLM wishing to qualify for the preferential treatment label must export 30% of basic models, containing 50% domestically-produced components. These companies are, however, authorized to make and export non-basic models using only 50% domestically-produced parts. They may also import materials up to 50% of the previous year's production.

"New" companies, such as Ford and GM, will be allowed to qualify for preferential interest, but will be limited to sales on the domestic market of only 10% of the total and must export 60% of their total output.

Spain is setting up an automotive industry with the deliberate intention of becoming a major exporter of vehicles. Present forecasts are that from a base in 1972 of 635,437 units, with exports of 107,445, by 1977 they could be making a total of 1.3 million vehicles, with about half a million destined for export. Reliable sources indicate that these estimates are conservative and total production could be as high as 1.8 million.

PRESSURES CAUSE ANXIETY IN EUROPE

The anxiety of Europe's established motor vehicle makers—already under severe pressure from Japan's dynamic and fast-expanding automotive industry—can well be understood. The prospect of another burgeoning automotive economy similar to Japan's right inside Europe is not being viewed with wild enthusiasm in some quarters of the European motor industry. This is particularly the case because the recent revaluation of a number of key currencies has made car prices in these countries rise sharply. And Spain's best market is already turning out to be the EEC. In 1972, nearly 60% of Spain's vehicle exports went to three countries: France, Holland and West Germany.

With this situation looming, manufacturers are adopting an "if-you-can't-beat-'em-join-'em" philosophy. But it is not always easy to hold in Spain. As one top executive put it, "In this way, we shall be able to share the rapid expansion of the Spanish domestic market and hedge our bets on exports." He made it clear that apart from anything else if a company wanted to invest in a plant in another country, Spain was as good a country as any.
Labor costs have not yet gone through the roof and, with preferential interest, economic conditions are both favorable and stable. There is an increasing tendency for the big international auto makers to spread their risks by placing plants in a number of countries and rationalizing manufacture and sales to export markets.

INVESTMENT POSSIBILITIES

What are the chances for a completely new company to make an automotive investment in Spain? With new investment—almost entirely foreign—amounting to over $1.6 million already earmarked, the chances on the face of it would not appear to be bright. With some of the leading European makers already well established and Ford and GM about to step into the picture, there wouldn’t seem to be too much slack to take up. Moreover, in recent times Spain has been tightening up considerably on foreign investment regulations. It is understood that the Spanish government is insisting on foreign investors entering into 50/50 partnerships with Spanish nationals.

Spain is still encouraging investment—allbeit within the framework of tighter rules. Experts believe that there is ample margin for new companies to make models complementary to the existing range. While the present rate of growth continues, this view would seem reasonable. Surprising absences are companies from West Germany and Japan—but these may yet come. Toyota has shown the most interest so far, but at the moment appears to be content to serve the Spanish market from a base in the Canary Islands.

The components, electrical equipment and supplier industries are also being built-up. Companies like IMENASA in Pamplona, FEMSA in Valladolid and FAESA in Barcelona, are already claimed to be competitive and growing fast.

The Achilles Heel of the whole operation could turn out to be the difficulty of finding adequate labor. The Spanish government intends doing all it can to attract back to the country those migratory workers who in the past have found work in other more prosperous countries. The government also recognizes that it will be necessary to set up training programs for specialized workers.

Single copies of this article are free. Circle BR7 on the Inquiry Card.

<table>
<thead>
<tr>
<th>Company</th>
<th>Prod. 1972 (units)</th>
<th>Prod. in 1977 range (units)</th>
<th>Exports</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEAT</td>
<td>317,000</td>
<td>600,000-750,000</td>
<td>150,000</td>
<td>Will invest in plants in Free Port of Barcelona and in Mataro and Zaragoza. 1,000 new jobs.</td>
</tr>
<tr>
<td>FASA-RENAULT</td>
<td>250,000</td>
<td>250,000-350,000</td>
<td>15,000</td>
<td>Will enlarge present factory in Valladolid. Completing new plant either at Palencia or Salamanca. Renault has 50% share in operating company.</td>
</tr>
<tr>
<td>CHRYSLER</td>
<td>35,000</td>
<td>160,000-220,000</td>
<td>30,000</td>
<td>Expansion. 30-40 new jobs.</td>
</tr>
<tr>
<td>AUTRI-LEYLAND</td>
<td>31,220</td>
<td>140,000-190,000</td>
<td>30,000</td>
<td>New plant for making engines likely to be in the Las Cuenca de Espina province of Castile. Total possible new jobs likely 5,000.</td>
</tr>
<tr>
<td>CITROEN</td>
<td>22,512</td>
<td>135,000-200,000</td>
<td>20,000</td>
<td>Present capacity in Free Zone of Spain will be increased. New plant for mechanical parts will be built—location not yet decided. 7,760 new jobs.</td>
</tr>
<tr>
<td>FORD</td>
<td>330,000</td>
<td>300,000-440,000</td>
<td>100,000</td>
<td>New factory—location undecided. 8,000 new jobs.</td>
</tr>
<tr>
<td>GENERAL MOTORS</td>
<td></td>
<td></td>
<td></td>
<td>Latest information indicates that GM may build new plant at Seville under umbrella of 'preferential interest.'</td>
</tr>
</tbody>
</table>

Single copies of this article are free. Circle BR7 on the Inquiry Card.
This automatic transmission input ring gear

Used to be made from a casting

Now it's made by Hot P/M Forming with 27% less scrap

Costly machining is also dramatically reduced with the "Hot P/M Forming" process. Fact is, two chucker operations were eliminated when the manufacturer of this transmission input ring gear switched to Hot P/M Forming.

What is Hot P/M Forming? It's the modern, lower cost way to make highly stressed parts—using preforms of metal powder. For this ring gear, the manufacturer selected one of Hoeganaes ANCORSTEEL® atomized steel powders designed specifically for Hot P/M Forming.

Are you involved with Hot P/M Forming? Or investigating it? Hoeganaes can help with a line of quality powders, like ANCORSTEEL 2000 or ANCORSTEEL 4600V, and other forgeable, heat treatable low alloy powders. And we'll provide information on how to successfully apply these powders to your special requirements.


The P/M Pros
Cut Time...
Prevent Waste and Mess

with Lincoln’s Fast Dispensing Systems for Sealants,
Adhesives and Coatings

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The system handles practically all kinds of sealants, adhesives, coatings, plastisols, paints, deadeners and even heavy mastics. Double-acting Pile Driver pumps keep the output constant and uniform on up and down strokes from normal plant air pressure. Air motors and pump tubes are interchangeable for complete versatility, with a range of ratios from 1.5:1 to 85:1.

Complete accessories include flow guns, spray guns, roller applicators, control valves, measuring valves, pressure primers and pump elevators. And Lincoln local parts and service are available worldwide.

Time and waste saved is money saved... and that's the benefit you reap with a Lincoln volume dispensing system. Mail the coupon now for full information.

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Please send Bulletin 417 on Lincoln dispensing systems.

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AUTOMOTIVE INDUSTRIES, January 1, 1974
Circle 125 on Inquiry Card
Press Loaded
By Robot Arm

With legal requirements forcing automated press loading and unloadings, there's growing interest in "convertible" units. That is, the possibility of adapting, or retooling the basic loader to a revised part design or even another job.

A Ford Motor Co., Cleveland, OH plant has already done it; sending an eight-year old Versatran programmable manipulator back to the Warren, MI AMF Div. for retooling. From prove-out trials, witnessed by AI, the principle looks good. It may prove especially attractive to smaller parts supplier plants.

Also, growing acceptance of these accounting practices has boosted the number of uses that can be financially justified.

The new application is a former valve cover feed into the handling unit by escapement on a belt-type conveyor. A "rubber" gripper picks up the deep-drawn steel part by one side. The robot-arm then swings around and feeds the part into the trim press.

Versatran engineers designed the conveyor to accurately orient and position several different valve covers for loading into the following trim press operation.

In detail, here is how the handling process works. The unit "dwells" over the pick-up position until a valve-cover drops from the conveyor into the load fixture. As parts drop into the fixture they are cushioned by sound-absorbent material.

The handling unit, with grippers open, clamps the part when the control receives a "part-present" signal from proximity switches in the loading fixture.

This arm then lifts the part from the fixture, "dwells" at waits until the control signals the automatic handler to feed into the trim press. When the "open" signal is received, the handling arm moves into the die area with the part; positions and releases the cover. It retracts to pick up the next piece-part. And finally it signals the trim press when the die area is clear.

This setup operates at a handling rate well over 600 piece-parts per hour (100% design efficiency)—much faster than many press systems now in use for such operations. Changeover from one cover to another, according to E. J. Van Home, manager of the Versatran AMF Div., is a matter of minutes.

Van Home notes that every handling setup engineered is run full-scale simulation in the Versatran Warren Application Laboratory for hours both for training and to minimize installation time and familiarization period. Tryout and acceptance tests run for as many piece-parts as the user specifies.

This particular unit formerly operated on a numerical control (N/C) tape that had to be programmed for each job. It is now updated with solid-state, (point-to-point potentiometer) electronics control. This greatly simplifies setup, as changes are merely dialed in.
United gives you The box that you built.

The LD-11.

We knew our shippers wanted a container larger than the LD-3. So we asked a cross section of our best customers, who we knew would speak for all our shippers, specifically what you wanted in a larger container. You told us you wanted:

1. Straight sides
2. Structured fiberglass body (weatherproof)
3. Tie-down (United's "Soft Touch") capability
4. One-seal security
5. Bars for garment-on-hanger shipments
6. Off-airport dollies
7. Full-width door opening
8. Internal height of 61 inches
9. Pull-rings and Push-plates
10. 6,300-pound-plus net capacity
11. Most important to many shippers, a Time-of-Tender rate structure.

You've got it. It's United's LD-11. It fits in all our 747's and DC-10's. And our "Daylight Savings" time-of-tender rates are designed to make it fit your shipping budget.

Typical "Daylight Savings" rate: 6,300 lbs. in one LD-11 container from New York City to Los Angeles for $482—only $7.65 per 100 lbs.

The LD-11 in action. United's newest lower deck container, the ten-foot-long LD-11, can move over 6,300 pounds of weather-safe, pilfer-proof freight.

UNITED'S LD-11

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>120&quot;</td>
<td>125&quot;</td>
</tr>
<tr>
<td>Width</td>
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<td>60&quot;</td>
</tr>
<tr>
<td>Height</td>
<td>61&quot;</td>
<td>64&quot;</td>
</tr>
<tr>
<td>Capacity</td>
<td>242</td>
<td>277</td>
</tr>
<tr>
<td>Cubic Feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Pounds</td>
<td>0,300 plus</td>
<td>1,800</td>
</tr>
</tbody>
</table>

Minimum Chargeable Weight (Pounds) 1,800

United Air Lines

Jet Freight No. 1 in the US sky
Electrics Take To The Streets

At the day of gasoline plenty pasts, the day of electric powered vehicles for use in cities may be arriving. Some municipalities, and the Post Office are examining the use of electric vehicles for pick-up and delivery purposes, to mesh with the present system of gasoline-powered, internal combustion engines used for heavier and longer distance hauling.

The Post Office, for instance, is studying the possibility of phasing out its 100,000 gasoline-powered fleet and replacing it with 3300 electric delivery vans per year. That is, if its evaluations under the Electric Vehicle Program prove out. The Post Office is testing electric for delivery van purposes in Cupertino, Santa Ana, CA, in Allentown and Bethlehem, PA, and in Lowell, MA.

In Allentown, the Post Office is testing a van made by Battronic Truck Corp., Boyertown, PA, powered by a 96 volt lead acid battery. Its top speed is 47 mph (76 kmh). After the vehicle is run on a variety of routes, carriers will be asked to rate the electric versus the conventional vehicle.

In summer storms, the pace of the Post Office's examination of electric vans is quicker. In Cupertino, CA, a test vehicle has been operating for a year-and-a-half on routes ranging from 8 to 15 mi (13 to 24 km) with 100 to 300 stops.

Data from the electric vehicle on daily mileage, power consumption, number of stops and general maintenance readings were compared to a jeep powered by a four cylinder internal combustion engine. Reported results showed that four mail delivery vans powered by lead acid batteries could be operated for the cost of operating one internal combustion vehicle.

As a result, Cupertino is planning a full electrification of its mail delivery. Thirty electric vehicles will be made in a joint British-U.S. operation. Harbilt Electric Vehicle Co., Manchester, England will build the electric propulsion system and Electric... (Turn to page 66, please)
When the makers of automatic truck transmissions turn to Torrington, can you afford to overlook us?

Hardly. We're pioneers in needle bearings. And still ahead of the pack. So it's natural that the people who design and build automatic transmissions for heavy-duty highway and off-highway vehicles come to us. If we can solve their problems, we can solve yours.

These transmissions use many types of Torrington Bearings to fight friction with precision:
- Drawn cup roller bearings, cage roller assemblies, needle thrust bearings with flat and lipped thrust races, clutch rollers and planet pinion shafts.
- That's a lot of bearings.
- But then these transmissions are a lot of transmission!

FOR ALL TYPES OF ANTI-FRICTION BEARINGS
THE TORRINGTON COMPANY
Bearings Division, Torrington, Connecticut 06790.
Electric Vehicles Inc., San Francisco, will assemble the vehicles. The vans will not need recharging more than every other day, and can be recharged by having the batteries connected to an industrial-type charger. They will have a 40 mph (25 kmh) top speed on a 2% grade and use two, 36 volt lead-acid batteries.

A lead acid battery-powered vehicle produced by Otis Elevator Co.'s Special Vehicle Plant in Stockton, CA is being used to test the feasibility of electric mail service vans in Santa Ana, CA.

A fourth vehicle the Post Office is evaluating is made by Otis Elevator Co. and is used in Santa Ana, CA. It can travel 40 mi (64 km) on one charge lasting about 8 hrs. Its lead acid batteries add 1340 lb (508 kg). The vehicle is said to be capable of a speed of 30 mph (48 kmh) on a 3% grade.

Don F. Crane, director of Fleet Management of the Post Office, feels that successful results in Cupertino and Santa Ana could lead to the introduction of electric vehicles in other warm cities, such as Phoenix, Miami, Memphis and Los Angeles. One other factor in site choice is the absence of hills. In time, a standard electric mail truck will be developed, it is said. The first Post Office orders are expected soon for a reported 350 vehicles, as a result of successful testing.

Other government bodies have also become convinced by arguments by specialized manufacturers, and industry groups, that electric vehicles have a role to play in a city's transportation and distribution systems.
Peel and Press!

Just peel the protective coating off this Tinnerman® fastener and press firmly to any clean surface. Presto, you've got a clamp that will hold wire, hose or tubing securely in position. Latches easily around the bundle. You save by eliminating panel holes, screws and rivets. It simplifies parts handling and speeds assembly operations. Made of durable polyvinyl chloride, the clamp resists vibration and will withstand temperatures from -40°F to 160°F. It's ideal for automotive, appliance and other applications where wire or hose removal presents service problems.

For information or samples call your Eaton fastener expert, he's listed in the Yellow Pages. Or write to Eaton Corporation, Engineered Fasteners Division, Dept 12, P.O. Box 6688, Cleveland, Ohio 44101.

In Canada, see Eaton Yale Ltd.
Seamless Bellows Assemblies

Robertshaw bellows assemblies can make your design for pressure or temperature control reality. Put your idea together with Robertshaw seamless bellows and assemblies for longer performance life and reliable operation. Choose from thousands of combinations of sizes, metals, and shapes — bellows diameters from \( \frac{3}{8} \)" to 6" — and larger if that's what your job requires.

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Circle 135 on Inquiry Card

Electromotion's vehicles will have support facilities set up around the Boston area.

(Continued from page 65)

Support facilities for electric vehicles are being set up already in the Boston area by a private manufacturer, Electromotion, Inc., Bedford, MA. A private dealership was also set up to lease electric to government agencies, commercial firms and individuals. Local government agencies, Electromotion reported, are considering the use of the electric for maintenance crews because of low operating costs.

Renewed interest in electric vehicles is also giving a boost to the design of electrics specifically to meet the unique factors created from Electromotion. Ordinarily, conversions have been the rule. A converted internal combustion vehicle is said to be improperly stressed for installation of heavy-duty batteries.

In Birmingham, a two-year test has begun on an electric van built by Antares Engineering, Inc., Troy, MI according to the design and specifications set by the Copper Development Association, Inc., a marketing arm of the copper and brass industries. The van will be put in service in the Water Meter Department.

The electric vehicle will average 40-50 mi (64-81 km) per day. The speed the vehicles will average is 37 mph (60 kmh). At 50 mph (80 Kmh) the range of the vehicle is said to be 44 mi (71 km). The van, called, Copper Electric Van III, is propelled by about 2400 lb-(1089 kg) worth of golf cart batteries. The van itself, without batteries, weighs 2500 lb (1136 kg) and has a cargo capacity of 1000 lb (454 kg).
Even if 1975 circuit designs are frozen it's not too late for thick film hybrids.

Centralab can help designers meet the challenge of today's technology changes with two thick film systems. Supplying custom requirements, from quick design to volume production is a matter of weeks.

Quick turn-around time is only one reason thick film circuits have gained such a strong foothold in many product designs. IC's require longer design lead time. Discretes can't match hybrids for size or reliability.

A case in point. Late in the design cycle for the 1974 passenger cars, governmental safety regulations called for changes in seat belt warning systems. A new seat-belt-ignition interlock would be required on all 1974 models. One major automotive firm brought their problem to Centralab. Hybrids could be the answer. Within two weeks, 8 packages had been designed by Centralab and samples shipped. Both active hybrid and passive circuits were included in the Centralab modules that were a major part of the interlock system. Two weeks later, prototype quantities were furnished and volume production quantities were shipped five weeks after that. From inquiry to mass production took a total of just 9 weeks! Tight scheduling. Exacting specs. Volume orders for millions of pieces. That's the kind of challenge Centralab meets best and the kind of service customers have come to rely upon.

Centralab, a pioneer in thick film circuits has also been supplying the needs of the automotive industry with other electronic components. Its broad line of products includes pushbutton switches, potentiometers, capacitors and ceramic substrates. All of these have been used in conventional AM/FM radio. With the advent of stereo tape players and the more sophisticated FM multiplex radio, adjusting the sound output of front and rear speakers became critical. Centralab developed a new potentiometer — incorporating a thick film resistor element on a ceramic substrate — that is now being used as a fader control.

In dashboard instrumentation such as sequential turn controls and tachometers, Centralab thick film modules have proven their reliability. And, ceramic substrates are being used in electronic braking systems, for solid-state ignition and in voltage regulators.

The list goes on. For, Centralab is no Johnny-come-lately on the automotive scene. Their years of experience in supplying quality components and customized circuitry for automotive electronics is unmatched.

You can put that experience to work for you — whatever your application. If it requires exacting specs, tight schedules, volume orders or other demanding parameters, get in touch with Centralab. They can help you meet the challenge.

For information on the complete Centralab line of electronic components — or any one of them — circle the reader inquiry card or write Centralab Marketing Services.

Circle 136 on Inquiry Card
Only one company makes the whole thing.

That company is Wagner. Our Skid Control System is completely manufactured by us. Not just the computer, but the sensors, the valves, the foundation brakes and the spring brakes. The whole thing.

And since all these components must work together for the system to work effectively, isn't it nice to know that one company has total responsibility.

What's the cost? The real price of any skid control system is its installed and maintained cost. And that's where we have more going for you.

Our components are small. So our system can be installed in spaces not large enough to hold other systems. And it's easier to locate our components on new and in-service rigs.

Our entire system and components are light. Our valves can be nipple mounted so they don't require equipment redesign or extra supports.

Our system saves air. There's more reserve available when you need it. And low air consumption means low equipment and maintenance costs.

Our exclusive valve design minimizes freeze ups. And the cartridge construction of our valves allows servicing in place without disturbing air lines.

Our wiring features foolproof, weather tight connections.

And even though our system is sophisticated, our sensors are simple. There's nothing to wear, no maintenance adjustments or special procedures needed.

And if you need more reasons why you have a lot more going for you with Wagner, all of these advantages are backed up by our exclusive support organization. This includes a skid control technical training facility for installation and maintenance personnel, and nationwide warehousing of parts.

Millions of miles of fleet service proves our system really works!

And we made the whole thing.

Wagner Electric Corporation, 6400 Plymouth Avenue, St. Louis, Mo. 63133.

Wagner makes other quality products, including sealed beams, miniature lamps, flashers, complete brake systems, and brake fluid.

WAGNER
We've got a lot more riding for you.

Circle 137 on Inquiry Card
The whole thing.

Air Actuation Systems

Computer

Sensors

Valves

Spring Brakes

Foundation Brakes

The Wagner Skid Control System.
We've put a new twist in energy-absorbing bumpers.

The heart of this self-restoring bumper system is a rotating spool... and the steel cables attached to it. Our tests indicate that it can prevent impact damage at speeds up to 10 mph. (That exceeds the 1975 requirements of NHTSA Safety Standard No. 215).

We designed it with steel-wire cables, which have the greatest load-carrying capacity of any steel product.

<table>
<thead>
<tr>
<th>Normal position—no impact load</th>
<th>Frontal impact</th>
<th>Angular impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake means rotation, converts bumper impact energy to frictional heat.</td>
<td>Impact moves bumper inward over frame extensions. This motion increases the length of cable required to connect bumper ends to disc brake; so bumper pulls on cables, rotates spool in brake unit.</td>
<td>After impact forces released, springs in frame extension return bumper to normal position; tension in保养 raises spool to initial position, excess tension in cables. Entire system is ready for another impact.</td>
</tr>
</tbody>
</table>
It offers these advantages:
It's lightweight—about the same as current 5-mph systems. It's tunable for any desired deceleration over a range of speeds and for vehicles of varying weights.
It places less demand on the suspension system. Shorter bumper travel adds less length to the vehicle.
And it protects against angular impact—up to 30°—as well as frontal impact.

The steel-cable bumper decelerator is another concept for the auto industry designed by U.S. Steel. For more information about the demonstration units we've built and tested, just call Bill Riffe, Automatic Marketing, in Detroit: (313) 354-4511. Or write United States Steel, Box 86, Dept. C103, Pittsburgh, Pa. 15230.
Digital Controlled Angle Iron Fabricator

Features and Specs: Combination punch and shear line with manual and automatic dial-in digital control system. Has built-in permanent memory for all nine AISC single-row angle chips for beam connections. A second memory unit is arranged to punch random hole patterns in each leg of an angle iron on one or two gage lines. Machine handles 40 ft (12 m) lengths of 2 x 2-in. (50.8 x 50.8 mm) to 6 x 6-in. (152 x 152 mm) angle iron.

Manco Mfg. Co., Bradley, IL.
Circle 40 on Inquiry Card

High Speed Lathe

Features and Specs: M300 Harrison 13-in. (33 cm) swing 3 lip precision geared head lathe. A construction feature is the universal quick change gearbox which provides for cutting popular thread pitches in the inch, metric, diametral pitch, and module systems.

REM Sales Inc., West Hartford, CT.
Circle 41 on Inquiry Card

Plastic Parts Extractor

Features and Specs: Simple single-point robot for automatic extraction of injection molded, compression molded or blow molded parts. It requires minimum floor space and can be easily relocated to accommodate production changes. Controlling the extraction cycle improves productivity by reducing scrap, increasing production rate, etc.

Robotics, Inc., Elnora, NY.
Circle 43 on Inquiry Card

Rubber IM Machine

Features and Specs: Designed for high-speed and natural rubber and thermoset plastics. The machine is used to have been designed to afford maximum protection for the plasticated tool until it enters the temperature-isolated mold where vulcanization takes place. The system obviates the need for restrictive one-way closure valves, long runner systems, intricate hydraulic controls and a host of other common rubber injection molding machinery impediments, it's reported.

The barrel of the plasticating screw becomes the ram and moves at a unit with the screw to inject the shot into the mold cavity. The holding chamber. Channel systems from the screw to the holding chamber are also eliminated.

Manco Mfg. Co., Bradley, IL.
Circle 42 on Inquiry Card

Roll mark permanent identification in metal parts

Chances are SCHMIDT standard marking machines and tools can handle most of your metal-marking applications. Quickly from stock they can be tooled with straight type holders and type, knurl holders and knurl type, roller bearing guides, etc., and shipped without delay. For specific marking problems SCHMIDT makes special machines and custom engraved tools.

SEND FOR DETAILS TODAY.

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6250 WEST HOWARD STREET, CHICAGO, ILLINOIS 60639, AREA CODE 312, 967-6250
610 E. PICO BOULEVARD, LOS ANGELES, CALIF. 90034, AREA CODE 213, 627-3337

Circle 139 on Inquiry Card

Circle 138 on Inquiry Card
We're telling your customers why the Heavy-Duty Road Gang is the power they need whatever their road, load, range, job or rig.

They'll be specifying the 30-SI charging system, 40- or 50-MT starting motor and the DC-250 battery—a perfect match to today's heavy-duty hauling.

The 30-SI is a workhorse unit big on muscle. And big on bearings, with generous grease reservoirs for long maintenance intervals. It has no brushes, slip rings or rotating windings to fail. The solid state regulator and diodes are located behind an access plate. Easy to service. No special tools required. And its 90-amp output gives you the power you need for the '70s.

Like all Road Gang components, the 30-SI and its companion pieces are torture-tested. Proved dependable in thousands of hours of lab tests and millions of miles in the field.

The Heavy-Duty Road Gang. From Delco-Remy. The electrical components your customers will be asking for.

Rig-matched Road Gangs, the Uptime Systems.

Delco-Remy
Division of General Motors • Anderson, Indiana

Our new H.D. Road Gang.
This is the power heavy-duty-truck buyers will be asking for.
Another new product from the new steel company.

MAXI-FORM 50: A high strength, free-forming steel puts parts and their production in top shape.

If you're forming complex parts requiring HSLA 50,000 psi yield strength steel, then MAXI-FORM 50 was developed for you. Many complex shapes can be formed with MAXI-FORM 50. For example, sizes to 0.180-inch-thick can take a 1/4T bend without rupturing or edge cracking. Thicknesses over 0.180 inch to 0.250 inch inclusive, a 1T bend. If you’ve been forming parts from 50,000 psi yield strength steel, you know that this is a new kind of performance. MAXI-FORM 50 can also be formed without worrying about transverse or longitudinal rolling directions.

But perhaps one of the best things about MAXI-FORM 50 is that it can save you time and money in production, over conventional high strength steels. It reduces downtime on production equipment by lengthening die life, and keeps rejected parts to a minimum.

If you’d like to find out more about MAXI-FORM 50 and our entire new family of high strength low alloy steels, write Republic Steel Corporation, Cleveland OH 44101.

MAXI-FORM 50 has three to four times greater transverse impact strength than conventional high strength low alloy steels at the same strength level. Longitudinal impact strength is also improved. Fatigue data available on request.

MAXI-FORM 50 has three to four times greater transverse impact strength than conventional high strength low alloy steels at the same strength level. Longitudinal impact strength is also improved. Fatigue data available on request.
Take the gamble out of assembly operations with Southern's precision milled slotted heads. The big payoff comes in cleaner, faster drives, with less downtime.

See your Southern distributor or write Southern Screw Company, P.O. Box 1360A, Statesville, NC 28677. Phone 704/873-7211.

Thread-Cutting Screws • Wood Screws • "Rolok" & "Plasti-Lok" Thread-Rolling Screws • Tapping Screws • Type U Drive Screws • Machine Screws • Continuous-Threaded Studs • Carriage Bolts • Stove Bolts • Speaker Screws • Hanger Bolts • Wood Drive Screws • Dowel Screws • Lag-Screws

Transmission-Oil Coolers

Features and Specs: Water-cooled oil coolers for automotive transmissions, including automatic gearboxes and torque converters, to handle oil flows from 5-45 gal/min (25-200 liters/min). Coolers are light in weight due to an aluminum body-casting and light tube bundle material. Also, space required is minimized by an advanced oil-coolant flow design which gives high heat transfer characteristics. One model is suitable for up to 120 hp and will cool up to 17 gal/min (65 liters/min), yet is only 18-in. (460 mm) long, 3-in. (85 mm) dia and weighs 9 lb (4 kg).

The Torrington Company, Specialties Division, Torrington, Conn. 06790.

We just got an "A" in Assembly

On this critical Federal Safety item—an automotive transmission-lock sprag rod, assembled by Torrington on a zero-rejects basis. And that's about as perfect as you can get in any rejects test!

After all, we've been making precision cylindrical parts and components for more than a century—shafts, spindles, pivots, dowel and taper pins—in any shape or hardness and with diameters ranging from .375" down to .020".

Our assembly business has been growing too because customers like our reliability.

If you're having problems getting precision metal assemblies, write for more information. Better yet, send a drawing or blueprint of the part or assembly you need, plus quantities used, to: SPECIALTIES DIVISION, THE TORRINGTON COMPANY, TORRINGTON, CONN. 06790.
Nine new anti-pollution options you can probably do without.

You decide.

These new Sno-Flake® plant production and maintenance chemicals won't save the environment. But they can help.

We've got a new body-in-white cleaner, for example, that cuts oily wastes by up to two-thirds.

A cold paint stripper that's phenol-free, and a hot one that's phenol-free, phosphate-free, and biodegradable.

A combination leak test dye and biodegradable car wash cleaner, and a final car-wash that's phosphate-free. And a highlighting compound that's non-flammable and doesn't produce any oily wastes at all.

A new solvent for removing excess urethane and other sealers that doesn't irritate the nose, and a glass cleaner solvent that doesn't irritate OSHA—it reduces volatility by 97%.

And a new bactericide that cuts down bacterial growth and odor in water test and rinse baths, in your plant.

Maybe you can do without our new anti-pollution options. Maybe you can't.

It's up to you.

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<th>MANUFACTURER'S SUGGESTED LIST OF ANTI-POLLUTION OPTIONS</th>
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<tr>
<td>1. THE BODY-IN-WHITE CLEANER (CUTS OILY WASTES BY TWO-THIRDS)</td>
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<td>2. THE COLD PAINT STRIPPER (PHENOL-FREE)</td>
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<td>3. THE HOT PAINT STRIPPER (PHENOL-FREE, PHOSPHATE-FREE, BIODEGRADABLE)</td>
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<td>4. THE COMBINATION LEAK TEST DYE AND BIODEGRADABLE CAR WASH CLEANER</td>
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<td>5. THE FINAL CAR-WASH (PHOSPHATE-FREE)</td>
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<td>6. THE HIGHLIGHTING COMPOUND (NON-FLAMMABLE, NO OILY WASTES)</td>
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<td>7. THE SOLVENT FOR REMOVING EXCESS URETHANE AND OTHER SEALERS (LOW-ODOR)</td>
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<tr>
<td>8. THE GLASS CLEANER SOLVENT (97% REDUCED VOLATILITY)</td>
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<tr>
<td>9. THE BACTERICIDE (CUTS DOWN BACTERIAL GROWTH AND ODOR)</td>
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GENTLEMEN:

I'VE DECIDED. SEND DATA ON THE PRODUCTS CHECKED.

[ ] PLEASE HAVE YOUR REPRESENTATIVE CALL.

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It may be a dream to you,
You, the guy who knows components better than anyone, also know the dream better: minimal driver and mechanical problems, maximum road time, reliability and profits.

That's why we're here.

Rockwell-Standard is committed to building quality-engineered, easy-to-maintain heavy-duty axles and brakes—the broadest, most reliable line in the business.

Look at the record. Our list of innovations includes problem-solvers like the first tandem axle—first successful truck wedge brakes, Stopmaster®—first cam brakes, Cam-Master™—the first pure digital skid-control system for trucks, Skid-Trol®—and the first tubular type trailer axles. As well as the first heavy-duty hypoid gearing for drive axles.

You also built the largest independent technical center for automotive components. To stay ahead in engineering, research and development. And we recently invested $130 million in the most advanced plants and manufacturing and quality control equipment available. Brake and axle production is way up, too. But after all the expenditure and hard work, we're still behind.

So what are we doing? Starting another round of capacity expansions as big as the one we just completed.

What does it all mean for you? Innovative products for one thing. Quality and quantity production, for another. To make your trucks more reliable, your operations more efficient and your profits grow.

Look, we don't claim that specifying our components will make your dreams come true. We do say it can make your days a lot easier, though.

Write for a brochure detailing our technical capabilities: Rockwell-Standard Division, Rockwell International, 1000 W. Maple, Troy, Michigan 48084.

MAK E YOUR JOB A LOT EASIER, SPECIFY ROCKWELL-STANDARD, BEST FOR THE LONG HAUL.
S-O-S Processor
Features and Specs: LSI-12/16 microcomputer features first computer processor on a single semiconductor chip using silicon-on-sapphire technology. It is an eight-bit digital automation microcomputer with four
1K to 12K words of semiconductor memory and an instruction execution cycle time of 2.64 microseconds. The new machine is available as a board-only system, packaged with memory, and operator console, and the same board packaged in a system enclosure with power supply, battery backup for the semiconductor memory, and card slots for additional input/output (I/O) boards. General Automation, Inc., Anaheim, CA.
Circle 72 on Inquiry Card

CO-HC Analyzer
Features and Specs: Infra-red CO-HC analyzer uses hermetically sealed detection system. After a 10-minute warm-up time, the new analyzer gives a 90% reading in 10 seconds. Performs at laboratory quality standards with ranges of 0-2000 and 0-1000 parts per million (PPMO) hydrocarbons, and 0-10% and 0-5% carbon monoxide. The total system accuracy of this instrument is 3% of full scale. Weighs 45 lb (20 kg). Robert Bosch Corp., Broadview, IL
Circle 73 on Inquiry Card

Fluidic Monitor-Controller
Features and Specs: Low-cost pneumatically operated quality monitor-controller can be used on-line to detect variations within ±3 di., thickness, edge position or cross-sectional area. Small, self-cleaning diameter sensing heads can monitor thicknesses down to 0.005 in. (0.127 mm), while edge sensor and control system is accurate to ±0.0005 in. (0.0127 mm) at high rates of speed. General Electric Co., General Purpose Control Products Dept., Schenectady, NY.
Circle 74 on Inquiry Card
A fastener is the least expensive part of your assembly.
The big money is in TOTAL INSTALLED COST

That's where TRUARc® retaining rings and assembly tools pay off fast—and you get the profits!

Fastener prices are just a small part of what you really spend on assembly. Your total installed cost includes three other elements: materials, machining, and assembly time.

When you use the Truarc Fastening System, you save on all three, without reducing product quality. In fact, when you use Truarc retaining rings, the chances are you'll have a better product—one that is more reliable, simpler to make, easier to service.

You can use Truarc rings to replace machined shoulders, nuts, threaded parts, set collars, rivets, cotter pins and many other fastening devices. You can eliminate costly turning, threading, drilling, tapping, facing and other machining operations. And with Truarc tools, you can literally slash assembly cost.

There's a Truarc retaining ring for every product: more than 50 functionally different types in over 850 standard sizes for shafts and bores .040" to 10" dia.—and rings as large as 40" dia. can be made for special applications. There's a complete line of Truarc pliers, applicators, dispensers, semi-automatic and mechanized tools for every assembly line—and Truarc rings are taped, banded and unit-packaged for fast, easy handling with the tools.

Find out for yourself how the Truarc Fastening System can lower your total installed costs. Write today for a free copy of the 128-page Truarc Technical Manual or call your nearest Truarc representative or distributor. They're listed in the Yellow Pages.

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84 AUTOMOTIVE INDUSTRIES, January 1, 1974
Electric Lift Trucks Branch Out

The electric lift truck is one more product getting new impetus during this period of reshuffling of old ideas due to the gas shortage. Previous electricals had already increased their competitiveness because of OSHA's insistence on less plant fumes and more silent equipment. A cause-effect relationship then, between the energy shortage and growing possibilities for electric lift trucks is incomplete. But recently, a rash of new electric industrial trucks have been released.

Two new lines were introduced recently by Clark Equipment Co's Industrial Truck Div. that have special industrial applications.

Clark's new electric lift trucks include one for use in narrow aisles (left) and another with a low profile for use in trucks, etc.

One line, for use in narrow aisles, comes with a 36 volt power supply for high-cycle, heavy duty operation, Clark announces. Offered in 2500, 3500, and 4500 lb (1134, 1588, and 2041 kg) rated capacities, the NP500 line will stack to heights of more than 264-in. (671 cm). A pantograph reach mechanism extends the forks 26.5-in. (67 cm).

The reach mechanism is said to allow the narrow-aisle truck to stack pallets at all levels of a storage rack. Load widths are not confined to the distance between the unit's outriggers. Wide loads can be picked up at floor level and pulled back over the outriggers.

The NP500 line incorporates a dual hydraulic system. Power steering and pantograph are served by one system and the lifting function by the other. This is said to reduce heat and to reduce drain on the battery. The use of brakes on both steer wheels is said to enable high-speed stops without swerving.

The other new line of electric lift trucks from Clark, designated the EC-300 line, has a low-profile (Turn to page 86, please)
Working Wheels

continued from page 88

The line features wheels for truck and railcar work. Optional tires for indoor/outdoor flexibility are available with this line.

According to Clark, this is the only four-wheel electric lift truck that offers a switch from cushion to pneumatic tires.

The EC-300 line offers 2000, 2500, and 3000 lb (907, 1134, and 1361 kg) rated capacities. A low overall height of 83-in. (211 cm) allows for maneuvering in low clearance areas.

A 48 volt option provides high lift speeds. Loaded, the 2000 lb (907 kg) model lifts at 95 fps (29 mpm), the 2500 lb (1134 kg) at 90 fps (27 mpm) and the 3000 lb (1361 kg) at 77 fps (23 mpm). The EC-300 3000 lb (1361 kg) capacity model has a wheelbase of 43-in. (110 cm) and a 65.3-in. (166 cm) turning radius. In turns sharper than 15 deg, the drive motor on the inside wheel is described as automatically "free wheel," allowing sharper turns in confined areas.

Applications for Electromotion's work vehicle include indoor and outdoor construction hauling and warehouse operation.


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Towmotor also deepened its product line in heavy-duty electric lift trucks recently by adding four trucks in the 6000 to 10,000 lb (2722 to 4536 kg) capacity range.

The new models, designated the M60, M70, M80, and M100, are offered with 36, 48 and 72 volt power selections. The 48 volt option was recently added to Towmotor's current line of electric lift trucks.

The M60-M100 trucks have travel speeds to 10 mph (16 kmh) and lift speeds to 90 fps (27 mpm). All seven Towmotor models have SCR electronic controls with stepless acceleration. All SCR elements (except operator activated ones) are grouped behind a heavy swing-open door in the rear.

Electro-Motion, Inc., Bedford, MA has had a hand in expanding the markets for electric vehicles, on the road and in the factory. The T/3 Electric Work Vehicle fills that definition, capable of heavy duty in the plant and outside.

Specifications include a top speed of 45 mph (72 kmh), a working range of up to 50 mi (80 kmh) between battery exchanges or recharging, and "fuel costs of less than 9¢ per mile," the manufacturer claims. The vehicle's life expectancy is reported to be 10 years or over.
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Operators who compare know why Millermatic means the finest in MIG. Sound, reliable welds. High speed. Continuous high quality output. Operators say: "Excellent metal deposition." "Measurable for welding off-the-ground... feared... Easy to learn." Millermatic equipment can be used where conventional power is not available—operated with a Miller engine driven welder.

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Elastomer/Metal Bearings

Design, performance, and application data of permanently lubricated elastomer/ metal bearings are given. Bearings are designed to accept shock loads and misalignments, eliminate objectionable vibrations, and damage to sensitive area. Emisloner Products Div., Milwaukee, WI.

Diaphragm List

A revised list of available models for producing diaphragm seals in form of a 28-page miniature catalog. Included are stock size seals, remote and local tested, all sizes. Bellofram Corp., Burlington, MA.

Small Tools

A 15-page catalog offers details on chucking tools, bushing tool holders, plain tool holders, revolving cutters, holders, and sleeves, boring bar cutter heads, bars, and sleeves, boring bar cutter heads for multiple spindle automatic machines. Described are chucking tools, bushing tool holders, plain tool holders, revolving cutters, holders, and sleeves, boring bar cutter heads for multiple spindle automatic machines. Balm Collet, Div. of the Warner & Swasey Co., Cleveland, OH.

Vacuum/Pressure Measure

Handbook for vacuum, pressure, and temperature measurement in gases and liquids. Outlines needed parameters for precise measurement of pressure and temperature in the range of 100 psi (689 kPa) to 10 bar (105 kPa). Aids in vacuum testing, material compatibility, pollution testing, and materials. Jerome Instruments, Inc., Wallingford, CT.

Pushbutton Switches

Lighted and non-lit pushbutton switches for industrial applications are described. These pushbutton switches are available as either standard industrial or individual switch assembly. They are rated 33 and 5 amp at 450 V, or 3 amp at 250 V DC. The switches are available in 2, 3, and 14 pole configurations. Clevland, The Electronics Div. of Eilen-Lucas Inc., Milwaukee, WI.

Sheeting Storage

Graph information on pre-punched sheeting and perforated metal, ideal for prototyping, cutting, and forming. Arcofoil Div. of the Warner & Swasey Co., Cleveland, OH.

Locknuts

Covers a variety of locknut products, including Michock, Miilik, and Miilock alike, along with best in locknut literature, as well as a list of special fittings. Everlock Div., Microdot, Inc., Charlotte, NC.

Electric Heater Manual

Comprehensive information on electrical resistance heating elements, wattage calculation, and thermal properties of the various metals. Included is a section on electrical heating elements, wattage calculation, and thermal properties of the various metals. Everlock Div., Microdot, Inc., Charlotte, NC.

Power Tool Accessories

Expensive accessories for a complete line of power tools and parts are described. Accessories include table jigs and milling, table saws, and milling machines. A good selection of common power tools and parts are included, along with common power tools and parts. Jerome Instruments, Inc., Wallingford, CT.

Pneumatic Accessories

Catalog contains fifteen categories, accessories and services for pneumatic systems, includes more than 50 individual catalogues, filter, regulators, and lubricators, and 25,000 items. Aeronca-Reed, Inc., Trenton, NJ.

Nodular iron Castings

Provides design engineers with the chemical composition, mechanical and physical properties of various grades of the cast material. Included in this section are new improvements in the design and manganese content, and improved quality control. Central Foundry Div., General Motors Corp., Saginaw, MI.

Ram Injection Machines

Describes horizontal, hydraulic clamp, heated clamp, cold-clamp, horizontal, and vertical injection machines capable of molding up to 200 lb at 100 tons of pressure. Various models are described, including those with temperature control systems, manually operated, and such machine types. Empire-Maquinarto Corp., Buffalo, NY.
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The Timken Company, Canton, Ohio 44706.