

E. P. Inc.

LEAD INDUSTRIES ASSOCIATION, INC.

292 MADISON AVENUE

NEW YORK, N. Y. 10017

January 28, 1964

SUBJECT: "The Picture Book of
Power Batteries"

To Members of the Lead Industries Association, Inc.:

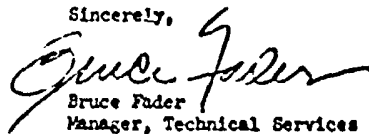
We are attaching a copy of our new brochure "The Picture Book of Power Batteries". This replaces "Power with No Strings Attached", issued last year, the supply of which is exhausted.

The new booklet is being released for review to publications in the materials handling and related fields. It will also be offered at cost to battery manufacturers, electric public utilities, and manufacturers of industrial trucks, vehicles and appliances for their own distribution, and will be mailed to our own list of about 8,000 design engineers. It will further be offered through our advertising in "Materials Handling Engineering", "Factory", and "Business Week" this year.

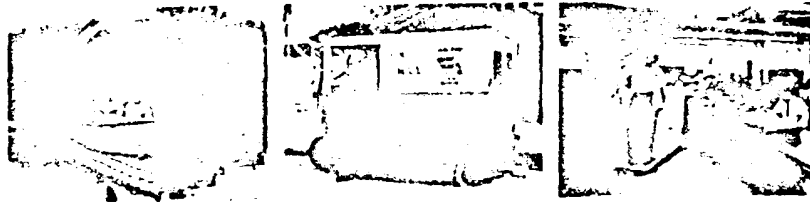
You will note enclosed in this brochure a "Directory of Battery Powered Vehicles and Appliances" which will be updated from time to time.

Additional copies of "The Picture Book of Power Batteries" are available to members free of charge in quantities up to 25 and at our cost of \$16 per hundred in larger quantities.

Sincerely,

Bruce Fader
Manager, Technical ServicesBF:bd
Attachment

Look Ahead with Lead



The **P**ICTURE **b**OOK



of **P**OWER **b**ATTERIES

LEAD INDUSTRIES ASSOCIATION, INC.

292 Madison Avenue • New York, New York 10017



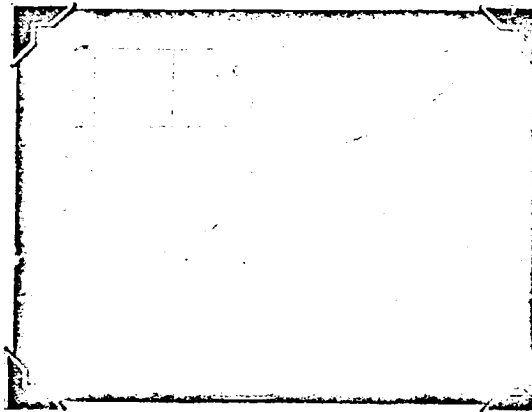
Look Ahead with Lead

The PICTURE BOOK

NOBODY could seriously question that doing away with all forms of mechanical power would plunge us back into the middle ages. Power, according to the dictionary, is "the rate of doing work." But it is more than that. Battery-powered industrial trucks can lift and move loads that men and horses simply can't handle. This sort of "get-it-done power" allows us to do work which we otherwise couldn't. Power tools let the home-owner mow his lawn and trim his hedge in an evening or afternoon without requiring any real exertion. This "convenience power" is a commodity which the public has demonstrated it wants. If you doubt it, try to get any housewife to swap her vacuum cleaner for a carpet beater.

Granted that the strong right arm and the team of horses are not going to regain the ground they've lost to mechanical power, what sort of mechanical power do people want to use? And here, of course, we must also ask, "To do what job?"

In a good many specific instances, the answer will be electric power from batteries. In warehousing or industrial operations using in-plant trucks, for example, studies have repeatedly shown that work done by battery-powered trucks costs about 60 per cent as much as with other powered trucks. In street delivery routes, battery-powered trucks pile up even more



THE COST PICTURE

Behind the shift to battery power is this cost trend picture. Since the war inflation has been general. Note that labor costs are especially important because of the very low maintenance labor requirements of battery powered devices. Two major exceptions to the inflationary movement have been electric power and lead-acid batteries. While figures are too general to permit plotting a cost trend, batteries have increased about twenty per cent in price since 1940—and their life has increased about fifty per cent in the same period!

of POWER BATTERIES

impressive savings—typically 2 or 3 cents per mile in the same service which costs 10 or 15 cents with conventional equipment. In the field of power tools, though battery power is still in its infancy, the convenience, safety, and complete mobility made possible by batteries is winning more converts every day.

No one needs to be told about the inflation in industrial costs since the war. Materials, power, and labor costs have rocketed to two and three times their pre-war levels. Happily, however, electric power is a unique exception—its cost today is just about the same as it was before the war.

Users of industrial vehicles, keeping close check of the total expenses, have found that maintenance of internal combustion engine vehicles has risen even more precipitously. The cost of a skilled mechanic has just about tripled since the start of the war. Since the host of moving parts in an internal combustion engine wear and are vulnerable to wear and breakdown, maintenance costs for these vehicles have risen drastically. Battery-powered industrial trucks, on the other hand, fare much better in maintenance since they have so few moving parts. This is why each year finds a greater proportion of battery-powered trucks in industrial service.

Throughout the past four decades, and especially

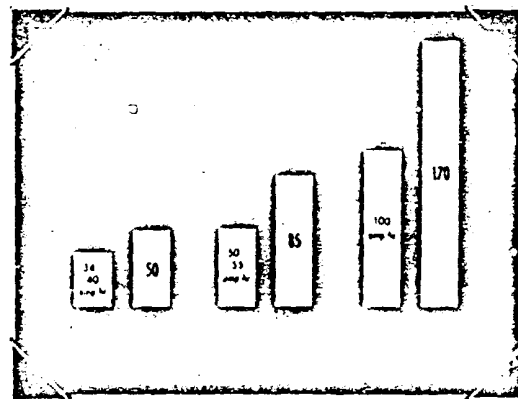
since the end of World War II, battery research has led to whole new breeds of lead-acid batteries for traction service and compact little battery packages that pack a real wallop of power. Wartime research has brought about wider use of other battery systems, too, so that battery power for special requirements is now available.

As a specific example, consider what has happened inside the lead-acid industrial battery during this period. In the first place, there are no more wooden separators between the plates. The job is done today with glass fabric or fibers in conjunction with plastic sheaths. In the second place, the old-fashioned hand pasting of the grids has been replaced with machine filling of the electrodes to match the new, rugged electrode design. The result has been that today's battery packs 170 ampere hours of work in the same space taken by a 100 ampere hour battery in 1950—and with less weight and better life.

Speaking of battery life, it is interesting to note that batteries are less expensive today than they were before the war when useful life is considered. The average cost for lead-acid storage batteries has risen twenty per cent in this period. The average life for lead-acid batteries has risen fifty per cent in the same period.

THE TECHNOLOGY PICTURE

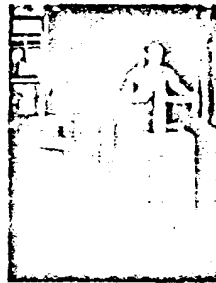
Today's industrial lead-acid battery is far different from its 1950 grandparents. Technical advances have been followed up by redesign and new manufacturing methods. The result is the increase in power storage capacity shown here.



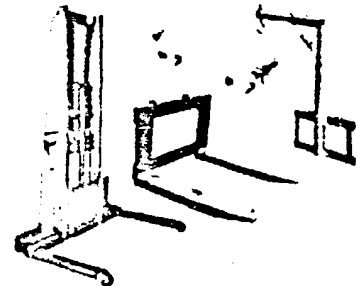
EACH FORK truck is
designed
for wide service.

Get-it-done power

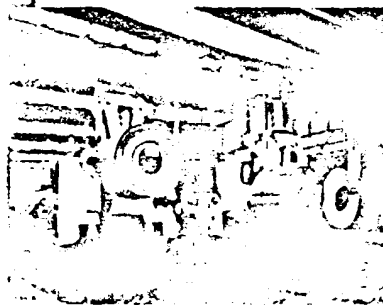
Lead acid batteries dominate the field when industrial vehicles call for real muscle power. The variety of in-plant trucks and special purpose vehicles using these batteries is incredible. Big flat-bed transporters purposefully shuttle between buildings of rolling mills with fifty-ton loads. One photographic film plant uses an enormous battery powered unit to stack and shift rolls of film weighing tons in utter darkness, reasonable quiet, and perfect cleanliness. At the other extreme are small motorized dollies with their own built in batteries which can be added to conventional hand power trucks to help out on ramps or with heavy loads. In between these extremes are the industrial workhorse trucks which nearly everyone is familiar with.



TRUCK TRAIN rolls smoothly along at five miles per hour. It hauls loads to three and one-half tons.



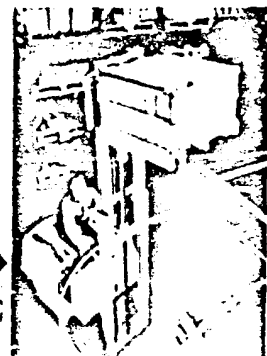
VARIETY of attachments shows for a wide straddle truck gives some idea of the versatility battery power is capable of.



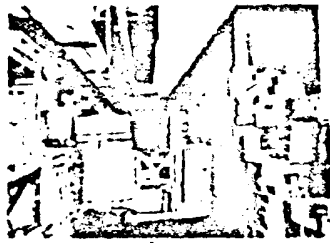
BRUTES — It takes a big front wheel to bear the load of the metal coils transported by these battery powered brutes.

LIFT truck is a familiar sight in the vast majority of American plants.

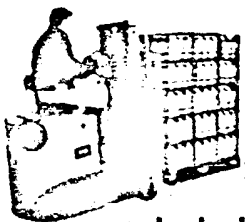
HIGH LIFT fork trucks are becoming more common as high space is put to work instead of going to waste.



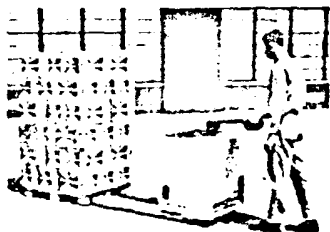
EXPLOSION PROOF—Battery power allows this truck to meet the stringent demands of hazard areas.



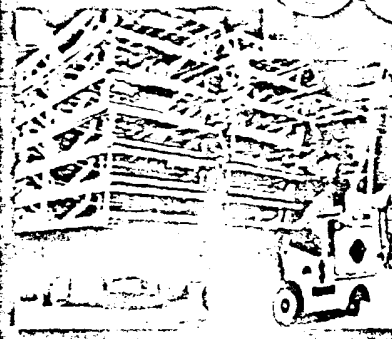
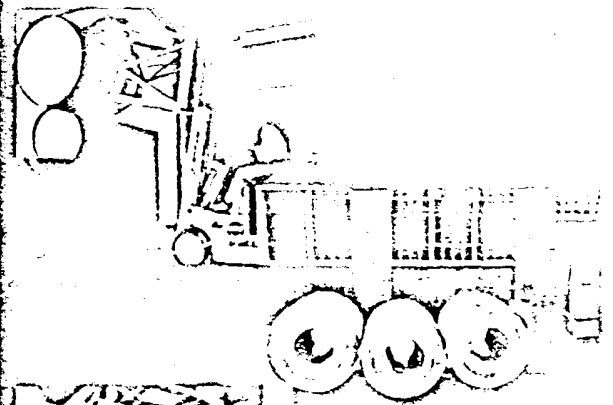
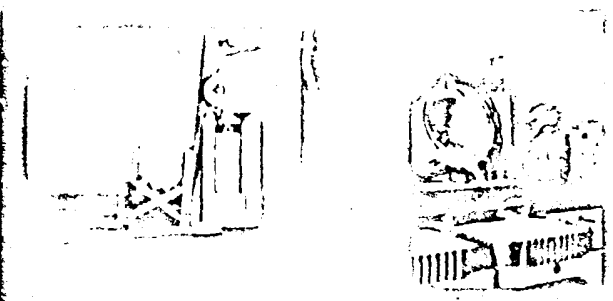
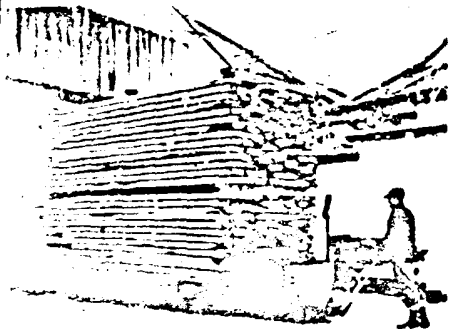
BELOW ZERO—It's gloves and pants worth, or for the operator, but the battery-powered truck performs dependably every day. Note reach-forward forks.

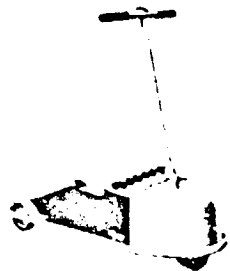


202 1/2 GALLONS of milk
—coming up!



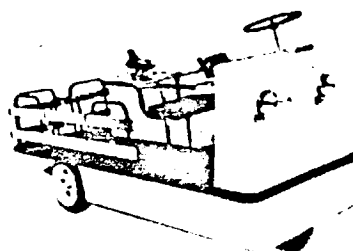
AND 756 QUARTS OF BEER—on the move!
Battery trucks move every imaginable product.



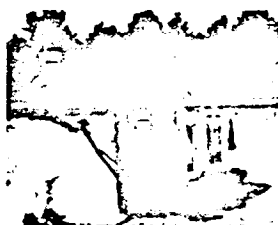


DO IT NOW! Here is a no-nonsense one man carrier which is speeding supervisory personnel and others about their rounds in large plants. Traveling at 10 mph the cart will go 28 to 48 miles on a single charge.

BOON TO ORDER PICKERS—the items go directly from the shelf to the front storage rack and the driver doesn't even have to get up.

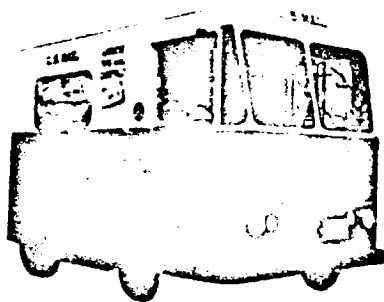


SHOP ON WHEELS—Room for a workbench and tools. The maintenance truck carries two men and everything they need to get the job done.



GET 'EM WHILE THEY'RE HOT—No noise, no fumes, no trouble maneuvering—they add up to food and battery power for this mobile food counter or for drive-in movies.

THE MAIL MUST GO THROUGH—and it does a ton and a-half at a time in this battery powered truck now being evaluated for city pickup and delivery. Operating costs are surprisingly low compared with conventional delivery trucks, hence the Post Office's interest in making the test.



Convenience Power

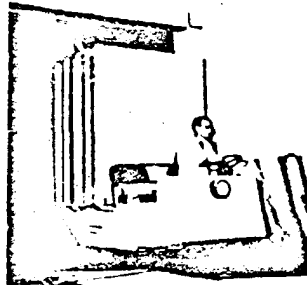
The lesson of in-plant trucks has been well learned in industry. The time and money they save has made them indispensable to profitable operation in most undertakings where they have been used. There is now a well-defined movement to explore similar opportunities for savings in other types of vehicles.

At first glance many of the battery powered units pictured here would appear to be conveniences—even luxuries—in the typical, busy industrial plant. Case histories where cost records have been kept prove otherwise. Look at the maintenance shop on wheels, for example. It's no joke to have to lug 300 pounds of pipe and tools to the job site. Nor does first class work get done when the right tools are lacking. The industrial maintenance crew may feel, under these circumstances, that routine maintenance chores can be put off another week, or month. What a difference the self-powered maintenance truck can make! It does the heavy hauling. And in addition to bringing the needed tools it has a built-in workbench with vise or other standard fittings. There's no smoke or fumes, no flying sparks, virtually no noise—the maintenance wagon is welcome anywhere in the plant, be it a clean lab or a hazard area.

The unspecialized personnel carrier is often used for small maintenance jobs, too. It's customary role is ready, reliable transportation for the plant superintendent or visiting AIPs. But it is such a quick and handy way of delivering an electrician or instrument repairman and his kit of tools to a distant location in the plant, that most of these carriers are kept busy all day. Pictures here show them at work in a food warehouse where a supervisor can get the latest order changes right to the work area, and on the Tacoma-Palmira Bridge in Philadelphia where they are used for traffic control and maintenance supervision.

And while general purpose vehicles are making new friends every day, there are a number of highly specialized battery powered devices that have come into use, too. Among these is the poultry feeder pictured here. The silence of operation peculiar to battery power makes it possible to use this unique machine without fuss and feathers in the henhouse. Its prime job is distributing feed mash in large poultry houses, but a quick change removal of the feed hopper and spout make it useful for egg gatherings, hauling sacked feeder, and other farm chores. Its operating cost is low; its safety, high.

PLANT TOUR SPECIAL: The young lady doesn't even have to raise her voice over the quiet hum of the electric motor.

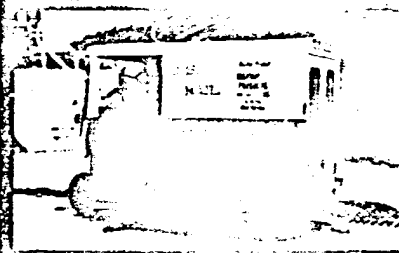
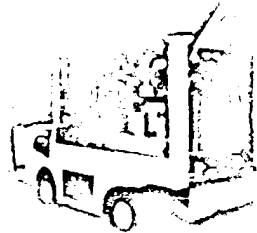
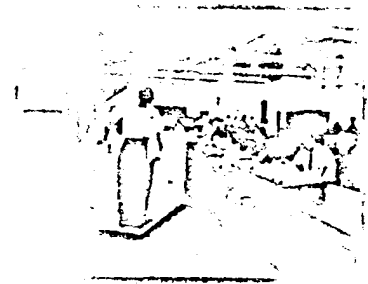


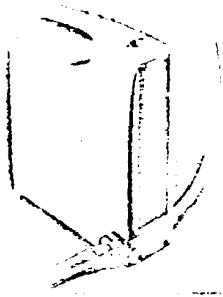
HANDY TO HAVE around the plant. As shown, the bed will take more than a ton-and-a-half. The same truck can be converted in minutes to a state body or a bus for VIPs.

ON THE SPOT — The supervisor just got a rush order on the phone and is making minutes count.



QUIET HENS AT WORK — The henhouse feeder is shown here distributing feed mash. On a return trip, with hopper removed, it will collect eggs.





ELECTRIC SHIP — Not quite all electric, the *Columbus*, full scale replica of America's first globe-grinding bark, uses lead acid batteries instead of top sails to navigate Disneyland's Frontierland River.



ELECTRIC PUMP — Boatmen, campers and others who have need of running water in unlikely places can use this three-gallon per-minute pump. Lead acid batteries form an "endless extension cord," enabling it to run seven hours on a charge. (The charger is built in and charging requires only plugging in to an electric outlet.)



Power with no

One by-product of the age of "do-it-yourself" hobbling and house repairing is a profound appreciation of the fine work done by Duncan Phyle and others of his ilk. It is almost inconceivable to the amateur how such precise work could be done with hand tools. Conversely, the hobbyist who first tries power tools is always impressed at how his skill is increased when he needs only to control rather than control and furnish muscle power to the tool.

It is this aspect of convenience power — power with no strings attached — which has led to the current boom in battery-powered tools and appliances.

But another facet of the convenience of electrical power is illustrated by the winch pictured here. Battery power from a car or truck battery, already in the vehicle, is easy to tap for accessory power equipment. Compare the ease of installation of a battery-powered device such as this to one operated by a mechanical power take off.

Lead acid aircraft to move the earth covered ring under test. The battery. The large of advice: Do not

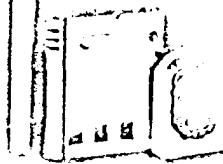


SAFETY — Would you dare do this with a conventional drill? The small battery unit shown drives the drill through 15 or 20 half-inch holes — a 12-volt car battery will run it all day.

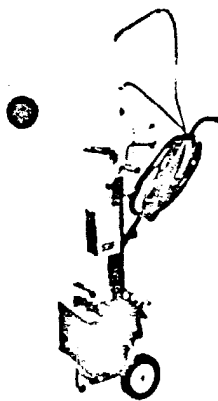


POWER TOOLS that go anywhere operate from 12-volt battery power. An automotive battery provides hours of hedge trimmer or edge clipping without recharging.

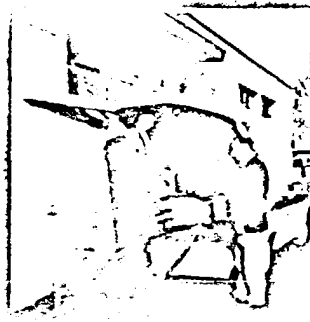
CRUISE THROUGH THE PARK — A delightful holdover from the St. Louis Exposition, these electric rental boats today continue to use lead acid batteries.



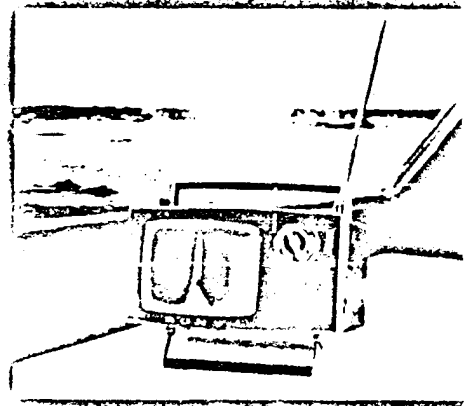
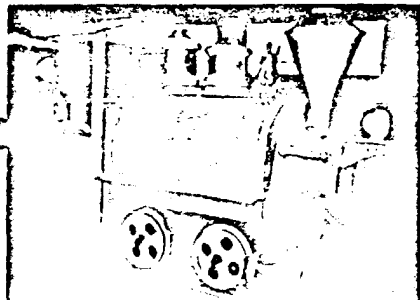
strings attached



HEDGES AND EDGES of well requested lawns require trimming and this power stand lets you do it effortlessly, electrically. The small gray box is a plug-in battery charger.



ELECTRIC LOCOMOTIVE — This one takes visitors to famous Knott's Berry Farm, California on smokeless inspection trips of the "mines." Lots of modern mine locomotives are battery powered, too.



Comparing Batter

Of all these various sizes and kinds of battery, which is best? There is no simple answer to that question. Each particular design situation has its own demands and peculiarities and some one battery system will probably meet them better than any other. The lead-acid system is nearly always a strong contender for any battery power job.

Suppose the question had been: Who is the greatest athlete in the world? The answer to this would certainly not be the world's heavyweight boxing champion because he could never place at a track meet. A star miler, on the other hand, might last only one or two plays in a college football game. No, the greatest athlete in the world would probably be a decathlon champion—a man who can do a number of things exceedingly well.

If there is a "best type" of battery, the lead-acid storage battery bids strongly for the title. It can "place" in every event of the battery olympic and it carries off the honors in more than a few of the categories. First, it stores a lot of power in a small and

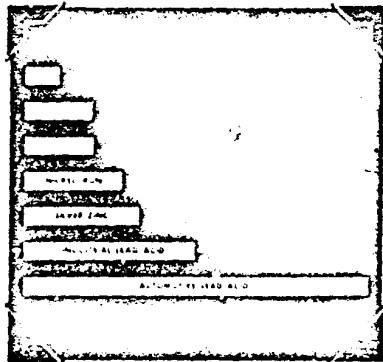
not-too-heavy package. Tests show that a typical automobile battery stores 1.3 watt-hours per cubic inch, 15 per pound. Admittedly, this record is topped by batteries using silver electrodes. They pack two to two and a half times as much power in the same space, five to seven times as much per pound. But they cost 20 to 25 times as much to buy and 45 to 95 times as much to use.

Now there are uses for batteries where cost is secondary in importance. Our space program, for example, has demanded ultimately high performance. But in the job of designing workaday products cost is always a factor in selection. If instead of looking at performance of batteries in a cost vacuum, we look at their power storage per unit of volume or weight *per dollar of cost*, the lead-acid battery leads the field. The two bar charts presented here, based on data from the table opposite, show that the lead-acid battery is a best buy.

To picture just how much power a lead-acid battery can store, imagine that you had a perfectly efficient hoisting machine designed for battery power. A typical automobile battery—your battery—could hoist itself about 7.5 miles into the air on the energy it stores at full charge.

But batteries do not always start a job with a full charge. They are sometimes driven beyond their capacity or used at extremes of temperature they were not designed to cope with. How does the lead-acid battery stand up under such abuse? Just beautifully! Granted that you can destroy any battery by abuse, if you set your mind to it, lead-acid batteries will take more punishment than any other kind except one, and lead acid beats it roundly in every other test.

The most telling figures on battery performance are those dealing with cost: cost of buying, cost of using, and the cost of associated equipment. In this decisive area lead-acid batteries are tops. The cost per cycle of charging and discharging an industrial lead-acid battery is only 1.3 cents (125, 100 amp-hr) while the next best battery comes in at 6.5 cents on the same basis. (These costs include the cost of energy and



Performance

amortization.)

Automotive batteries, operating under conditions far from ideal from a battery standpoint, cost 13 cents per full (100 amp-hr) charge-discharge cycle. This is a conservative figure. More graphically, it is roughly equivalent to a cost per start of one cent if you start your car three times a day. Suppose you had to crank your car to start it. Would it be worth one cent to have it started for you? That cost applies to those cold mornings when the car is covered with snow, too. And the battery didn't spend the night in a warm bed or have a cup of hot coffee before you

got into the car. If one cent is too much money for starting the car under these conditions, the battery will throw in lights, radio, and heater operation, and it may even open and close your windows or adjust your seats.

If you are looking for a power source with no strings attached, get to know the lead-acid battery. He's a tough character, able to stand up to punishment. He's a hard worker with real muscle power. And he gets the job done without fuss or frills, without any special care or equipment, and nearly always for a lower cost than any other battery.

Table 1. Performance of automotive batteries under various conditions. (Data are for 100 amp-hr batteries.)									
Battery Type		Temp., °F.	Charging Current, amp.	Discharging Current, amp.	Charging Time, hr.	Discharging Time, hr.	Efficiency, %	Cost per Cycle, ¢	Notes
Flooded	Normal	70	5	11.1	1.15	10	10	10.5	10.5
	Winter	10	6	14.0	1.0	10	10	10.5	10.5
Nickel-cadmium	Normal	70	10	11.0	0.6	10	10	10.5	10.5
	Winter	10	10	11.0	0.6	10	10	10.5	10.5
Sealed	Normal	70	5	11.1	1.15	10	10	10.5	10.5
	Winter	10	6	14.0	1.0	10	10	10.5	10.5
Gel-cell	Normal	70	5	11.1	1.15	10	10	10.5	10.5
	Winter	10	6	14.0	1.0	10	10	10.5	10.5
VRLA	Normal	70	5	11.1	1.15	10	10	10.5	10.5
	Winter	10	6	14.0	1.0	10	10	10.5	10.5

Here's Help in Selecting Battery Power

Lead Industries Association's technical staff has the following literature available to help in the selection of batteries and battery powered devices —



Industrial Truck Cost Calculator — a simplified calculator which allows you to estimate the cost of owning, operating, and maintaining battery-powered and other industrial trucks. It performs a complete cost analysis in five minutes.



The Choice of Battery Systems — reprint of a paper before the Society of Automotive Engineers by C. G. Grimes and W. S. Herbert. Examines all contemporary battery systems, their advantages and shortcomings.



Electric street delivery trucks — reprinted from *Food Processing*, this article explores the economics of electric trucks for route deliveries of milk, baked goods, and similar services.



Directory of battery powered vehicles and appliances — (copy enclosed)



Directory of manufacturers of lead-acid batteries — lists manufacturing companies, types of lead-acid battery produced, ratings, and miscellaneous information.

Technical or product inquiries will also be given prompt attention. Write to:



Battery Desk
Lead Industries Association
292 Madison Ave.
New York, New York 10017

Look Ahead with Lead