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# POPULAR MECHANICS

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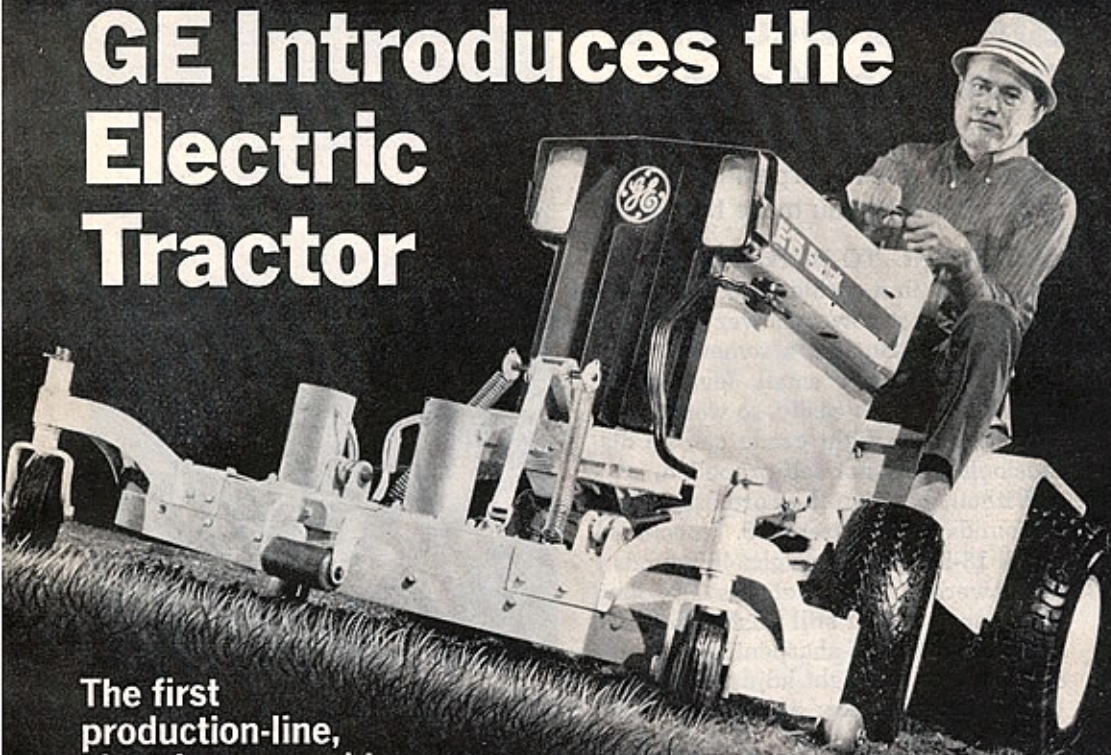
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# GE Introduces the Electric Tractor



The first production-line, electric-powered home garden tractor, GE's Electrak, is cool, quiet, safe and vibration-free. Its electric motor develops amazing torque. And it takes the electric plug outdoors to power a complete line of tools—or anything you plug in

By JAMES M. LISTON, Executive Editor

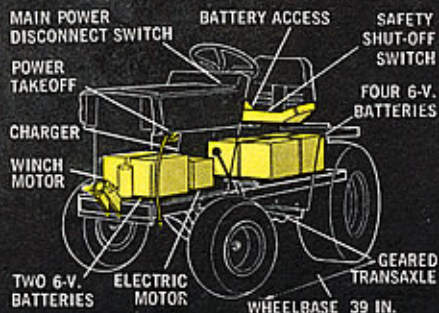
Photos by Burns Photography, Inc.

**T**HIS MONTH GE—yes, General Electric—will introduce an electric-powered home garden tractor that can mow up to 3½ acres without recharging. The Electrak packs plenty of power for plowing, tilling and snowblowing. You can fell trees or shave with it. One of its attachments, a new electric chain saw, plugs into the power takeoff. And—if you use an inverter—an electric shaver or any 115-volt a.c. tool or appliance you choose can be plugged in.

Three models of Electrak will compete with 10, 12 and 14-hp conventional tractors and, while prices haven't yet been announced, "will be priced at mid-range with competing stock."

The Electrak is the brainchild of fast-moving Bruce R. Laumeister, developer of GE's Delta electric car.

"In three years we produced the equivalent of five model years of electric tractors," he says. "We're ready now with three models that will outperform 10, 12 and 14-hp conventional tractors. We developed our own







**ELECTRAK HAS REAR-DISCHARGE**, front-mounted mower (opposite page) with separate motor for each blade. Its weight and torque make it ideal for bulldozing, plowing, tilling. Tools that can be plugged in include drill, hedge trimmer and electric chain saw. Standard 115-volt tools can be used with an inverter that costs under \$100



full line of attachments and believe we have the safest mower and the best snowblower in the industry."

Laumeister, who lives on an acreage, has an engineer's intolerance of poor design and performance.

"I wasn't satisfied with several conventional tractors I wore out," he says. "That's how I got started looking for a better answer."

To avoid questions from his neighbors about the project during the period of field-testing, Laumeister mowed and plowed late at night. He had no complaints from the neighbors—proof that the Electrak was quiet. And proof that GE is convinced he is onto something big is that the corporation has set up a new outdoor power equipment operation which he now manages.

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***The mower is shock-mounted;  
you can hit a tree . . . and  
not break the mower mounts.***

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Laumeister believes the cool, quiet, vibration-free ride is an advantage buyers will recognize quickly.

On the dash of the Electrak are two gauges—"Fuel Level" and "Power Use." "Fuel Level" shows the amount of charge in the batteries; "Power Use" indicates the rate at which power is being used. Plowing takes a lot of power; ordinary mowing requires little. At the right of the dash is the drive lever, with forward, neutral and reverse positions. The more you advance the drive lever, the faster you go; it acts as the throttle.

A speed-selection lever offers four speeds: D-2 is the highest, 7 mph, for plowing snow, towing a cart. D-1 is typical mowing speed; L (low) is for heavy pulling, tilling, fast snow-blowing; LL (low low) is for heavy snow-blowing, deep plowing.

The "sound of silence" takes a while to get used to, and men who like a tractor to sound like a tractor may feel let down when they turn the key

starter. I drew a blank the first time I started the Electrak.

"I have the key in the on position," I said to Laumeister. "What am I doing wrong?"

"Nothing," he said. "It's on."

I moved the drive selector forward and took off. There are no neck-snapping starts. You take off smoothly and the tractor accelerates rapidly. If you listen carefully you hear a series of clicks. These are the relays and contacts that program the motor control. The control has a "memory" that won't let you go through the control and apply torque faster than the control will allow. The same thing happens when you shift from forward to reverse. It won't let you jerk-start or jerk-reverse the motor.

"There's a brake pedal on the left," said Laumeister. "You should use it before reversing. If an electric motor is going fast in one direction, it's possible to reverse it, but it does the motor no good. If you try to do this too fast, the circuit breaker will cut out. You'll have to wait a moment for it to come on, so you don't gain anything by 'shifting on the run.'"

I headed the Electrak for a bunker on the grounds of the GE Research Center. I'd been told it was a 40 percent grade. It was covered with an inch of snow; I doubted that I could climb it without chains. I stopped at the foot of the grade and selected D-2. The Electrak climbed the full length of the hill without wheel spin. Heading down, my first inclination was to hit the brake, but the dynamic braking effect of the electric motor held the tractor down to the same speed at which it had climbed.

We mounted a snow blade on the tractor—a simple matter of inserting a few hitch pins—and placed the blade against a concrete curb. Laumeister put the Electrak in Drive and the wheels continued to turn, burning rubber. A 200-pounder added weight by standing on the rear axle. The tires smoked, but the electric motor continued to run. (Try that with a gas engine and it will

stall out.) Laumeister did it to show the tremendous torque developed by the motor. Coupled with ideal weight distribution and a control system, it lets the motor deliver full horsepower—through a conventional geared trans-axle—to the drive wheels.

When GE engineers "started from scratch" to design the Electrak, they worked overtime on new safety features. One of the best—a safety cutoff switch—prevents accidental restarting. When the driver leaves the seat, the mower blades are braked to a stop in less than three seconds; the tractor stops and brakes. It cannot be restarted simply by remounting. To resume operation, you bring the drive lever back to neutral and move it again in the direction of travel. The mower is then restarted by switching the PTO to off and then on again.

Pressing a main power disconnect switch (at the driver's left) completely disconnects the battery pack from the tractor. It can be used for an emergency stop or to prevent operation when the tractor is stored.

The 42-inch, rear-discharge mower is a three-blade rotary; each blade is powered by its own small d.c. motor. The mower floats on ball joints and is shock-mounted. If the mower hits an obstacle, the shocks absorb the impact. You can hit a tree with it and not break the mower mounts.

The mower lift mechanism is a simple electric winch using a nylon webbed belt as a lifting cable. GE engineers demonstrate its capacity by standing on the mower and being lifted as the winch operates. When raised, the mower can be flipped for cleaning and sharpening.

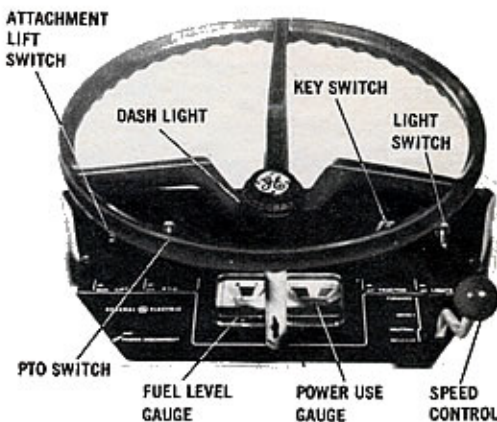
The Electrak has an unconventionally short wheelbase for its size—39 inches to allow a 47-inch turning radius.

"The short wheelbase was designed to get better maneuverability with the front-mounted mower," said Laumeister. "If you have a long wheelbase with a front cutter, you end up turning cir-

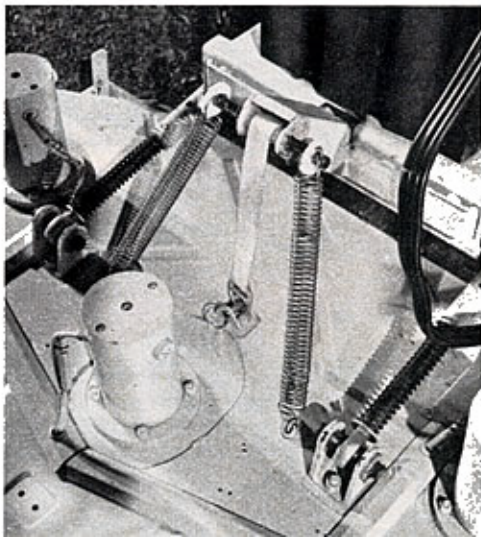
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**MOWER CAN BE FLIPPED** for cleaning, sharpening. A prototype is shown; mower now has three blades



**GAUGES ON DASH** show amount of charge in batteries, rate at which power is being used. Mower (below) floats on ball joints, and is raised by an electric winch with a rugged nylon belt as cable





(Continued from page 123)

cles so big you can't cut a corner of the lawn without a lot of jockeying."

The short wheelbase was possible because of evenly distributed weight. A conventional tractor (with front-mounted engine and front-mounted mower) would be nose-heavy with a 39-inch wheelbase.

"The Electrak has almost the same pounds per square inch on front and rear wheels," said Laumeister. "The average tractor has 2 to 1 on front and rear—because of the engine—and the greater weight is on the front where you don't want it."

The Electrak weighs 865 pounds; battery weight accounts for 350 pounds. Four six-volt batteries are in a closed compartment under the driver's seat. Two more and the motor are under the hood.

"It's that weight distribution that lets you climb the hill without wheel-spin,"

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### **Battery weight an advantage ... most tractors need additional weight for traction.**

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said Laumeister. "In an electric car, the weight of the batteries handicaps performance. In a tractor, battery weight is an advantage because most tractors need additional weight for traction. By putting battery weight in the right place we use it to get a tremendous amount of drawbar pull. Secondly, a gas engine develops its maximum power only at high rpm. The electric motor develops its rated horsepower at high rpm, but as you slow it down it develops up to 10 times its rated torque."

The motor in each Electrak model is capable of putting out up to about 20 hp on peak loads. The motors differ only in the amount of time that each will sustain the peak load. The reasoning behind this: People will buy 14-hp tractors to have extra power when they need it. In most applications they use much less. E-20 is the "Commercial" model designed for professional groundskeepers. The E-15 outpulls standard 12-hp engines; the E-12 outpulls 10-hp engines.

GE is reluctant to discuss the motor other than to say it bears no resemblance to the type used in electric cars and is a "very heavy industrial-grade motor."

"It is unique," says Laumeister. "There's nothing like it in any other vehicle at present. The motor and the control system are electrically integrated and matched."

GE also makes the batteries, guardedly referred to as "a new wet-cell type."

How many hours of use can you expect from the batteries?

"That depends on the job," said Laumeister. "One day we cut an alfalfa field about 1½ feet high. We had the mower at a low setting, which is a ridiculous application. Our power lasted two hours; we cut two acres. Normally the charge will last 2½ to six hours. It may last three or four hours if you're doing average mowing; five or six if you're towing a cart."

Does this leave you stalled in the field, far from an outlet for the charger?

"You won't 'run out of gas' because toward the end of the charge the voltage drops off; you feel the tractor or the mower blade slowing. Even if you run the Electrak to a standstill, just let it sit for five minutes and the batteries recover sufficiently to take you home. When the fuel gauge shows 'Empty,' you still have enough to return to a power source."

Will you run out before you finish?

"If you have over 3½ acres," said Laumeister. "Let's say you go out at 8:00 o'clock in the morning and cut 3½ acres (that's a lot of mowing) by 10:00 o'clock. You can recharge and go out at 4:00 o'clock and do as much again, because most of the charge is replaced in the first four or five hours. Batteries charge very fast and then taper. You have to put the taper in because it equalizes the cells, but the actual power is restored in four or five hours. Our built-in charger is designed for that. After a complete discharge, it takes about 10 to 12 hours for a 100 percent charge. However, in the first three hours you restore almost half the charge; in the first six hours you replace three-quarters of the charge."

How long will the batteries last and what will it cost to replace them?

"With normal care, we expect them to last 8 to 10 years. They carry a five-year warranty. Replacement cost should be between \$16 and \$32 per battery, depending on type purchased. But since recharging costs only pennies, you might say that included with the Electrak is an 8 to 10-year fuel supply."

Another plus for the Electrak: It doesn't have to look far for a "gas pump." The home electric outlet licks a common problem for mower pilots—running out of gas on Sunday when local stations are closed.

It remains to be seen whether an electric tractor will appeal to men who like the sound of an engine when they pour on the power. GE is aware of this; Laumeister seems happy about a slight natural gear noise that comes from the transaxle when the tractor is under load. ★ ★ ★