

Newport's

Heavy Duty Trucking

THE BUSINESS MAGAZINE OF TRUCKING

EQUIPMENT

BATTERIES

CHARGE IT!

Electrical loads on highway trucks are dictating a need for a more versatile battery – or a complete rethink of the electrical storage system.

Batteries are second only to tires when it comes to breakdown calls. The frequency of dead batteries and call outs for jumps or snatch tows costs fleets thousands of dollars each year.

Yet by the application of new battery and electrical technologies, much of this unscheduled downtime and expense can be eliminated. New-technology storage batteries are available that package the plates and electrolyte in revolutionary designs that greatly extend battery life, functionality and cranking power. And now there's the asymmetric ultra capacitor, a new electrical storage medium that can actually start a truck with an effectively dead battery, pulling it up by its own bootstraps.

While we have had maintenance-free batteries for years — a major boon to fleet operations — the type 31 battery found throughout heavy-duty applications is still basically a conventional battery with lead plates and sulfuric acid electrolyte. In its most basic form, the battery is faced with competing needs in a modern, over-the-road truck: high current for starting and deep-cycling for what are becoming known as the "hotel" loads of the sleeper.

Some of the newest batteries feature changes to the plates and plate supporting grids that improve performance while also extending battery life in the typical high-vibration, severe service of a truck application. The DayStarter MX grid technology, for instance, provides a rigid base to allow for a lead/tin plate that is

claimed to outperform batteries with a lead-calcium alloy. According to DayStarter, the grids allow for significantly higher cur-



System approach will save batteries.

rent for good cold-cranking amps with the ability to deep cycle the battery for current draws in excess of 20% of the battery's capacity.

RoadGang batteries are part of the Road Gang heavy-duty system by DelcoRemy. The company recommends not only the deep cycle batteries for a reliable system, but using them with a low-voltage disconnect switch. Along the same lines, Kenworth announced earlier this year it will make LVDs standard on certain sleeper models.

Some of the newer premium lead acid batteries introduce a new feature: an absorbent glass-mat (AGM) electrolyte containment that means there's no free sulfuric acid sloshing around inside, as is the case with the conventional flooded battery. Examples include the Delphi Freedom and Freedom Extra and the Guardian by Douglas Battery. Then there's the revolutionary-looking and, to a significant extent, revolutionary designed Optima, recently acquired by Johnson Controls' and sold under its own name

or through Interstate Battery. Because the electrolyte is contained in the glass mat, the AGM storage batteries can also be mounted in virtually any position and orientation because they are leak-proof, said Pankaj Dhingra, business line executive for Delphi's Freedom. An alternative electrolyte containment uses a gel, as in the Deka batteries by East Penn Manufacturing. In both cases, electrolyte leakage is prevented — even if the battery is punctured.

The glass-mat construction brings other major advantages, said Dhingra. Delphi's Freedom has more than twice the cycle life of a conventional flooded battery. And the assembly is under pressure so the plates are much more resistant to vibration — the No. 1 killer of truck batteries.

The vibration resistance comes from the added mechanical strength of the mat that provides additional support to the lead alloy in the battery's plates. This is important in a truck, especially one with the battery box cantilevered off the frame rail.

In the Optima battery, the plate-support concept is taken even further. This battery looks most like a big yellow or red soda six-pack. Each of the cells has large sheets of almost pure lead with the electrolyte-loaded mat sandwiched between them. These are then rolled into a spiral and inserted under pressure into the case. The nearly pure lead and the minimal interior connections allow the battery to deliver an especially high cranking current while being able to sustain deep cycling. And with its unique construction, the Optima is claimed to be as much as 15 times more resistant to vibration and



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Senior Editor



Absorbent glass mat feature makes the Delphi Freedom Extra battery leak-proof.

shock loads without the plates separating.

According to Jay Kedia, commercial market manager for Optima, the very low internal resistance from the few internal connections means the batteries will hold a charge for considerable periods — twice as long as a conventional battery. And this translates to a long shelf life in storage, too.

A completely different electrical storage medium to the conventional — and even these unconventional lead-acid batteries — is the ultra capacitor. The technology is being introduced to North America markets through consolidated efforts by cold-start experts KBI, headquartered in Lake in the Hills, IL., and a Russian producer/supplier company that is also the technology proprietor.

With the lead-acid battery, electrical energy is stored by performing a reversible chemical reaction inside the battery. It is forced one way by applying a voltage, and it gives up its energy when a current is drawn. Even in the very latest designs, the reaction takes time to

complete and it has an inefficiency that generates heat. The battery also has an internal resistance, so even without an external load, it eventually runs down over time. And while the new designs are extremely good at providing good cranking current, it takes a top-of-the-line battery to optimize for the two competing requirements on a truck: a good cranking battery and a good deep cycle battery to run sleeper loads. And, however good, a conventional battery wears out.

In the capacitor, the electrical energy is stored physically as charges on two minutely separated plates; the more area, the more energy. Capacitor self-discharge is very low, so the capacitor will hold its energy for months and months. It's no good for sustained current and won't run sleeper loads but it's great as a starter source because it doesn't have to wait for a chemical reaction to give up its charge. The ultra capacitor can deliver a huge current instantly—and can be dangerous because of this. And it can pick up that charge from an almost exhausted conventional battery. One way to think of it would be as an electrical equivalent of an air starter.

Like the air starter, the ultra capacitor is potentially best used in a combination installation with deep-cycle lead-acid batteries. And a big plus: Based on the work performed by KBI's Russian partners, the ultra capacitor has the potential to outlast the vehicle.

As well as the elimination of problems with run-down batteries that fail to crank over an engine, the ultra capacitor can bring a number



Optima battery features advanced spiral-wound plate design.

of additional maintenance benefits, says KBI. Potentially, it can replace several of those conventional lead-acid batteries, saving weight. The capacitor can be cycled 300,000 plus times — outlasting the truck — and at the same time protect the conventional vehicle battery, giving it a much longer life. In fact, long after a lead-acid battery can no longer crank an engine, it can satisfactorily provide for the electrical loads on the vehicle, enormously extending its useful life.

Because vehicle system voltage is maintained during capacitor engine cranking, starters last longer. And using an ultra capacitor in the electrical system acts as a major filter, smoothing voltage spikes to give a longer life to electrical components such as alternators and headlights.

Today, the ultra capacitor has one big drawback — cost. But even that is changing (see below). It may well be the truck electrical storage system of the future will be a combination of new technology batteries and an ultra capacitor.

ULTRA CAPACITOR

The combination of ultra capacitor for starting and deep-cycle batteries for a truck's electrical and hotel loads looks like a winner, says Rick Capps, special projects systems engineer of the Nevada Automotive Test Center, a contract facility much used by the military. "The technology is not down the road,

it's now," he says. And even though the ultra capacitor is expensive today — it's currently around \$800 — Capps reckons the lifecycle costs will put the capacitor/battery system ahead over the life of a truck.

In most applications, fleet specifiers might find it hard to justify such a cost, even trading off a cou-

ple of vehicle batteries. Bulk haulers may be able to rationalize the expense from the nearly 100-pound weight savings. But pioneer KBI's ultra capacitor supplier maintains the payback can be as little as a year when factoring in the savings and the uptime guarantee of the capacitor starting system. And that's at today's cost of building the ultra

capacitors in the supplier's Russian plant and shipping them here.

Even so, KBI and its partner are working hard to fix the ultra capacitor's perceived cost drawback.

They are currently looking to establish a joint venture to manufacture the KAPower-branded capacitors in the United States, where they predict the cost per kilojoule will drop approximately 50% from the current 10 or 12 dollars. Ultimately, when mass production is finally realized and using the latest designs, materials and production techniques, costs could be reduced by an additional 50%, to around \$200-\$300 per install.

And when they do, says KBI vice president Jim Burke, they will release a log-jam of demand. The technology is not only attractive to heavy truck users, it has wide application in the military, farm and construction, standby generation, even the uninterrupted power supply industry. Burke and his Russian associates anticipate a rush to reap the benefits of the ultra capacitor.

THE TECHNOLOGY

Capacitors are not new. In fact, their characteristics have been well understood since first demonstrated by the physicist Hermann von Helmholtz in the late 19th century. This century, capacitors have been fundamental parts of tuned electrical circuits, and they are extensively used today in watches, PDAs and phones to maintain memory during battery changes. But the big, industrial-sized ultra capacitors have, until now, been more difficult to develop and implement, says Burke. With the introduction of the asymmetric ultra capacitor by the Russian technology company, there's a capacitor that will do the job.

The Russian company officers have invested five years and thou-

sands of miles in rental cars taking their innovative asymmetric ultra capacitors to a diverse cross section of industries all over North America.

At the same time the Russians were beating on American doors, KBI's Burke and his father — company founder and president James W. Burke — were casting around

pletely discharged. Using a stack of four small, three-volt, photocell type batteries, they managed to build up enough charge on the capacitor to fire up a heavy-duty diesel engine.

IMPLEMENTATION

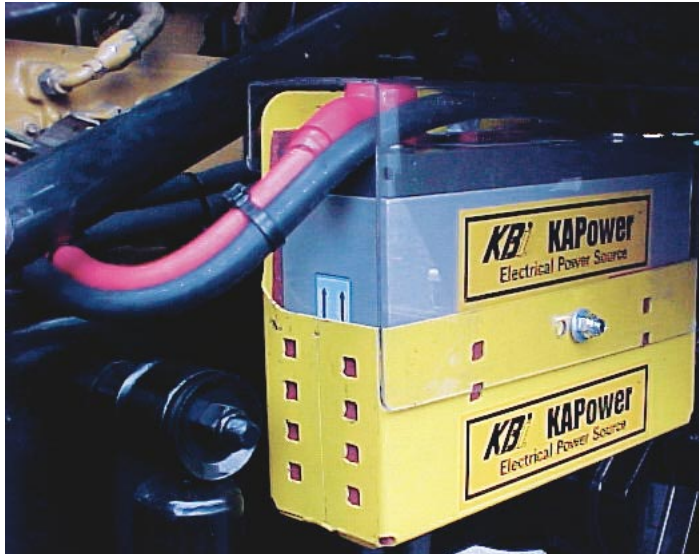
Starting a diesel with camera batteries is just a side-show example,

but KBI has already developed and introduced the KrankingKart a jump-starting cart utilizing the ultra capacitor technology. You could, says Burke, have a truck with a battery voltage of around 10 volts that is effectively a lost cause for starting. Bring up the cart, connect the cables, and the residual energy in the batteries will build a charge in the ultra capacitor. Within seconds, the KrankingKart will start the truck.

Again, that would be a trick, because shops would conventionally leave the cart charged, bring it to the truck to jump it, then leave the device connected to the vehicle for a few seconds to re-establish the full charge. The KrankingKart can then be left for months before it is needed and still have a full charge on the capacitor.

In vehicle systems that are completed for development and evaluation, the 27-pound ultra capacitor substitutes for two of a truck's batteries, saving more than 90 pounds. It is wired in parallel with the remaining one or two batteries there to run lights, sleeper loads and other vehicle electrics. There's an isolator/starter switch so the ultra capacitor can be removed from the circuit except for starting and charging — though this is not essential.

Several evaluation programs by end users have been completed. At Ryder Transportation Services, equipment evaluation team leader Tom Shupbach ran several tests substituting the ultra capacitor for one or two batteries in a four-battery system. While the team was



This light weight ultra capacitor has plenty of energy to turn over a diesel.

for a synergistic technology to their Kold-Ban Dieselmatic ether-starting product. This product, which has been refined over several decades, guarantees a diesel start however cold the environment, providing the engine will turn over. What KBI was looking for was an advanced and reliable technology that would guarantee to do it. When a KBI group happened to bump into the Russian delegation at a heavy-duty OEM's engineering department, both sides realized it was a perfect solution for guaranteed starting of heavy-duty engines in any environment.

The technologies' combination opens up some remarkable possibilities. The ether start is too familiar to need explanation, though it's worth noting that the latest generation ties directly into the engine ECM to make it completely automatic and seamless for the driver. The ultra capacitor needs some introduction to understand how remarkable a starting aid it can be. According to Burke, as a demonstration, they took an ultra capacitor starting system that was com-

able to verify the capacitors worked, the high initial cost and several operational issues have meant the program is on the back burner.

Operational issues included a need for education, says Shupbach. "We had instances where an engine manufacturer would blame the capacitor (system) without trying to find what was wrong. They would disconnect the capacitor when it was mounted close to the starter — which is where they should be. There needs to be education to the suppliers of other vehicle components."

According to Shupbach, though, if the cost can be reduced to KBI's target, then he says Ryder could build a business case for using the alternative technology to save the company's high cost of replacing conventional lead acid batteries.

In the meantime, "We're waiting to see where it can go," he said.

The military is extremely interested in the technology, because vehicle batteries represent a huge cost, handling and tactical problem. One of the projects under investigation is a batteryless start-



KBI's KrankingKART already utilizes ultra capacitor technology for fast and efficient heavy-duty starts.

ing system based on the KBI/KoldBan Dieselmatic ether start and the KAPower-branded ultra capacitor.

According to the U.S. Army Tank-Automotive and Armaments Command (TACOM), advantages include maximum power on demand, recharge from a start in five seconds and the opportunity to charge via a standard NATO slave receptacle when necessary.

Important for the military is the fact that the capacitor has no hazardous materials in its construction, greatly easing the handling, storage and paperwork involved over standard batteries. The military also sees the wide operating range of -58 to 122 degrees Fahrenheit as a major plus for the starting of its vehicles. The fact that the batteryless truck dispenses with four conventional batteries not only saves weight, but the relatively small size of the capacitor and controller mean

they can be packaged more easily on the truck, says Jim Miodek, business development manager of U.S. Army TACOM. ■

The Future is Now

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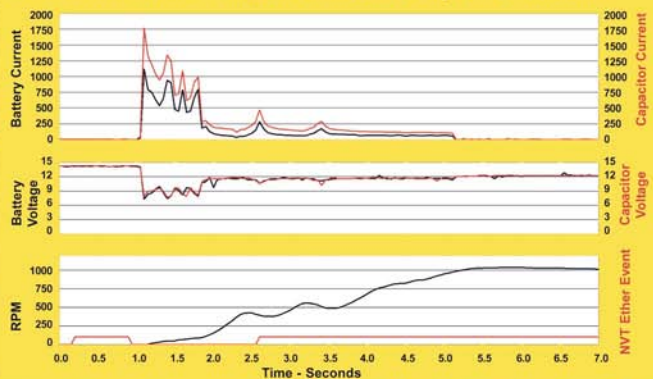
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 Test Temperature: -5°F (-21°C) Test Engine: 12.7 Liter with Trans. Capacitor:(1) KAPower 60 KJ
 Cold Soak Duration: 22 Hrs. Prepared for Subzero Cold Starting Battery: (1) Group 31



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