How do battery chargers work

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Photo: Solar-powered battery chargers, like this one made by BEAM, are sure to become increasingly common as more of us switch to electric cars. The overhead canopy contains a 4.3kW, photovoltaic, sun-tracking solar paneland feeds onboard batteries so it even works at night. It can charge up to six electric vehiclesat a time. Photo by Erin Rohn courtesy of US Marine Corps and DVIDS.

If you"ve read our main article on batteries,you"ll know all about these portable powerplants. An example of what scientists refer to as electrochemistry,they use the power of chemistry to release stored electricity verygradually.

Photo: Ordinary batteries (like this everyday zinc-carbon battery)are only designed to be used once—so don"t attempt to recharge them. If youdon"t like zinc carbon batteries, don"t start trying to recharge them: buy rechargeable ones to begin with.

All battery chargers have one thing in common: they work by feeding aDC electric current through batteries for a period of time in the hope that the cells inside willhold on to some of the energy passing through them. That"s roughlywhere the similarity between chargers begins and ends!

There are, broadly speaking, two different ways to charge a battery: quickly or slowly.Fast charging essentially means using a higher charging current for a shorter time,whereas slow charging uses a lower current for longer.That doesn"t mean the charging process is just a simple matter of passing a steadycurrent through the battery until it"s charged.There are several common methods of charging (plus a few more we won"t go into here).[1]

Photo: Battery chargers look simple, but they"re surprisingly complex inside.Different types of rechargeable batteries need charging in different ways, for different times,sometimes using several different methods in turn, which make up what"s called the charging algorithm. A charger like this is constantly sensing what the batteries inside it are doingand adjusting the charging process accordingly.

In taper-current charging, the charger starts off using a high, constant current,which progressively lowers to a trickle as the battery fills with charge and reaches its peak voltage. Inexpensive chargers often work this way.[8]

Photo: This "fast-charge" battery charger is designed tocharge four cylindrical nickel-cadmium (nicad) batteries in five hours orone square-shaped RX22 battery in 16 hours. I think it"s an example of a constant-currentor maybe taper-current charger, though I"ve not tested it to find out "s easy to use, and just as

easy to misuse: there"s nothing to tell you when charging is complete. With a battery charger like this, charging batteries is complete guesswork.

The final method is called trickle charging, and is similar to constant current charging but uses a much smaller current (perhaps 5–10 percent) for much longer. Some appliances (like cordless phones and electric toothbrushes) are designed to sit on trickle chargers indefinitely.

Graph: Batteries get harder to charge in the later stages. It can take as long to charge the last 25 percent of a battery (red area) as the first 75 percent (orange area). [2]It"s worth remembering this if you have limited time to charge a battery and worry that it"ll take too long: you might be able to charge it halfway in much less time than you think. If the battery in thisexample takes an hour to charge, you can see that it would reach 50 percent charge (dotted lines)in just 6.5 minutes.

Different charging methods are suited to different types of batteries. Simple pulse charging works well for nickel cadmium and nickel metal-hydride batteries, which are also widely charged by the constantcurrent (CC) method, but pulse charging is quite crude and unsuitable for lithium-ion batteries, which are generally charged by CCCV instead.

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Web: https://sumthingtasty.co.za/contact-us/
Email: energystorage2000@gmail.com
WhatsApp: 8613816583346