

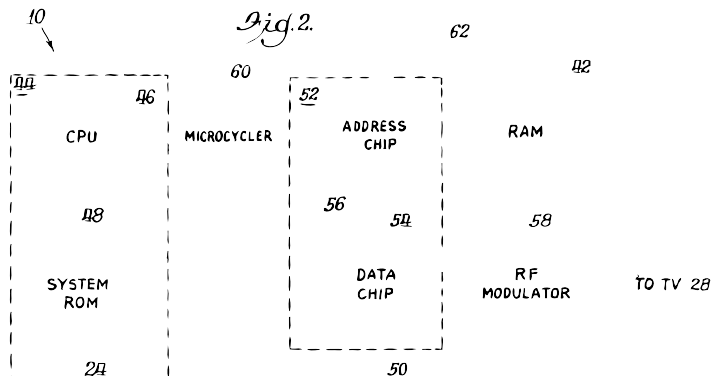
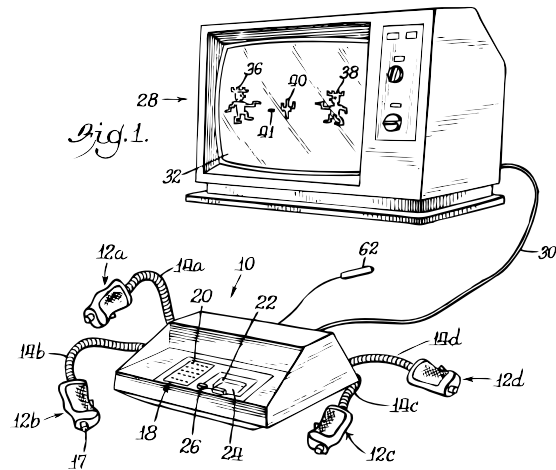
# There is no reason anyone would want a computer in their home.

Quote attributed to Ken Olson, president of Digital Equipment Corporation, maker of business computers in 1977.

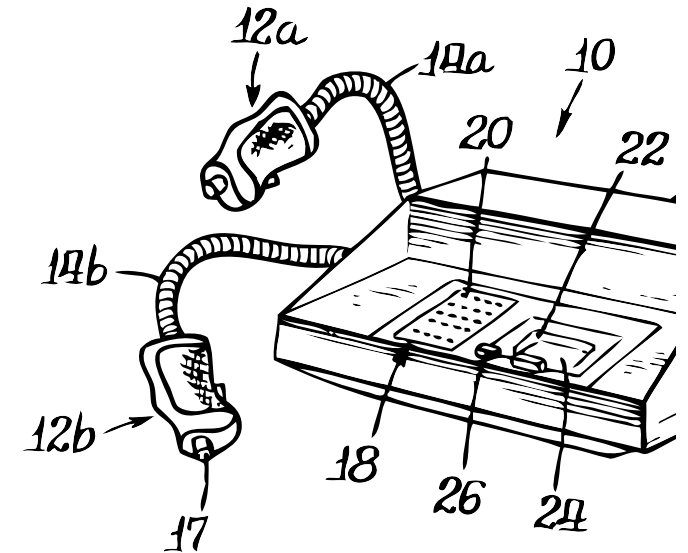
*standardized plug for electric bicycles*

*2008*

U.S. Patent Nov. 17, 1981 Sheet 1 of 84 4,301,503



"Home Computer" patented by Frederiksen 1981



## Visions

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 2008

## Present

Currently engineers spend their time modifying electric drive systems for every minor change in the system, such as the battery's chemical materials, instead of designing new innovations.

**Public charging, battery-swapping, renting and leasing solutions for LEVs are virtually impossible or involve high risks for the operator.**

- 1 State of charge (SOC)** is the ratio of remaining battery capacity to rated battery capacity. SOC is used to estimate battery power time (BPT), which is the remaining electrical power supply time based upon the power demands of the equipment in use. SOC can also be used to estimate the time required to fully charge a battery using a particular charging station.
- 2 State of health (SOH)** is the physical condition of a battery. SOH is used to estimate losses in rated capacity, as well as predicting impending failures such as shorts or severe corrosion.
- 3 State of life (SOL)** is the remaining life of the battery. SOL is used to estimate the number of remaining charge/discharge cycles for a battery.
- 4 Vehicle to grid (VTG or V2G)** is the use of combined battery power taken from many vehicles connected to the power grid to supply sudden demand in the grid. This means that the charging of the vehicle will be disrupted and the energy flow reversed. The customer will sell this energy back to the grid for a higher price.
- 5 Intelligent networks** give the electricity provider control over high volume utilities like fridges or chargers. Through minimal changes in the AC frequency these devices can be notified that a demand or surplus in the grid exists, and the device can act upon this (operational in Japan).

## With EnergyBus

With the **EnergyBus** the electric propulsion system is open for future innovations and easily expandable with future technology. Of course, we could not think of everything but here are some ideas to give you examples of what is possible:

Public charging and battery-swapping stations as well as renting or leasing business models are made possible with **EnergyBus**. An anti-theft device can block all components if no key is present. Personal mobile devices like cellphones, digital cameras, music players can be powered and charged with a simple adapter. Cellphones can be used as interface devices to the vehicle displaying speed, battery-level, position and other available data from the bus.

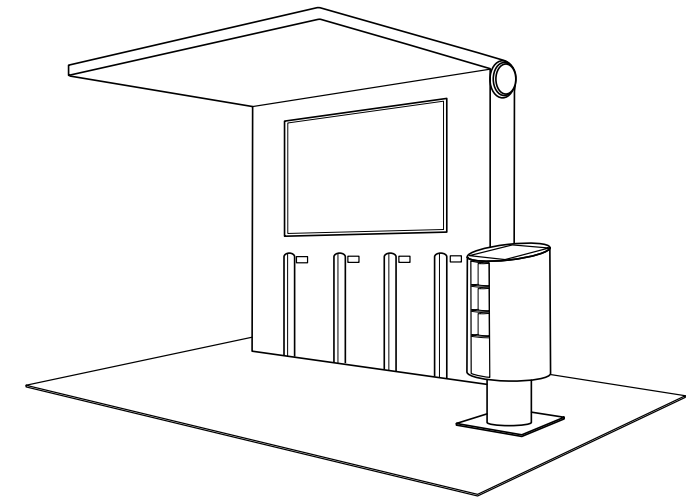
The integration of photo-voltaic or fuel cells in the system can be as easy as updating the controller's software. Hardware profiles can trigger different functions depending on which devices are connected to the bus. If a solar cell is detected, its power is completely used for running the motor while exceeding energy charges the battery. Battery power is used, if there is not enough solar power. Dealers can update the software of the controller and exchange any component of the system to meet the customer's wishes.

Assistance profiles can be chosen through display (sportive, relaxed, normal). Service notices could be displayed on the controller if the SOH2/SOL3 of the battery reaches a certain level.

Additional sensors and devices connected to the bus can enable more functions in the controller: Positioning systems may enable the controlling device to output a message, such as: "Not enough battery capacity to reach destination, do you want to drive with less electrical assistance or drive to the next charging station (1km)?" Couriers could see a choice of routes to the next target as a result of battery SOC,1 orders and hills/charging possibilities on the way.

Heartbeat sensors could enable control over a defined training target or safety level. The controlling device could output a messages, such as: "Your output is higher than your preference. The system is increasing the assistance until your heart-beat comes back to a normal level." or "Your output does not match the selected training level. The system is starting the recuperation mode". Vehicle to grid4 (VTG or V2G) solutions and intelligent networks5 are possible with **EnergyBus**. Plugging your vehicle on a public charger may result in a prompt: "You are plugged into a charging station. Do you want to fast-charge your bike, wait till there is cheap peak power, or sell energy into the grid?" or "Your LEV has no energy flat rate account with us. Please insert your credit card to charge your LEV."

**EnergyBus makes the future of light electric vehicles possible.**



Pedelec rental station with battery swapping facility