

NEWS

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APR 83

Electric Auto Association

1249 Lane Street

Belmont, California 94002

(415) 591-6698

Walter V. Laski, Publisher

Vol XV No 4

EPCOT

What does EPCOT mean to you? This acronym means Experimental Prototype City Of Tomorrow to Disney World Co. personnel but, after visiting EPCOT, to me it means Electric Powered Cars Of Today or electrification in a big way.

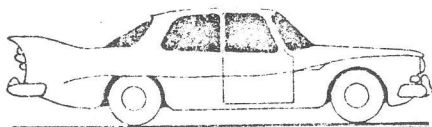
When you first arrive you are impressed by a modern monorail system. This is a fourth generation monorail train. The first Western Hemisphere monorail was unveiled in 1959 at Disneyland. Now it is a semi-automatic train system with a capacity of 250 people per train of six beautiful streamlined cars. This 10 train fleet travels 500,000 miles per year. The average down time for maintenance of each train is only 1 hour per year while providing service for an average of 19 hours per day. Each monorail is powered by eight 200 Hp. 600 volt traction motors. 20 million passengers are carried per year at a cost of 0.15 cent per mile seat. (15 one hundredths of a cent) We wish we could do this good.

This quiet clean train goes right thru the lobby above the people in their New Concept Hotel. Now that is really utilizing real estate when you can build and house people over, beside and under an electrified freeway.

Your next ride on an electric vehicle might be at Disney World People Mover. This is also a fourth generation development. It has proven to be the most dependable fully automatic people mover in service today, 99.6 % reliable. It can carry 3560 passengers per hour at 7 miles per hour. It goes thru the attics and back stages of the Disney shows. It is quietly propelled along without intervening gears, belts, or other mechanical devices. Rectangular electromagnetic linear motors are attached to the roadbed between the guide rails. The motors react upon an aluminum-faced plate which is mounted beneath each car. The air gap between the motor and plate is .15 inch. The motors produce a maximum of 125 lbs of thrust and require 240 volts, 60 Hz, 40 Amps to operate.

At EPCOT Energy Pavillion built by Exxon you are in for a surprise ride in a first of its kind, electric vehicle. This pavillion has thousands of small mirrors covering the walls and solar cells on the roof. This photovoltaic array is the size of a football field and provides 55KW peak electrical power. At this building you are treated to a short stand-up picture show, then allowed to enter a theater. You are seated for a wide screen show. The next thing you know is that the whole theater of 600 people is moved forward.

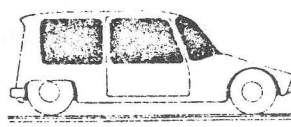
1960



1980



2000?



Between 1960 and 1980 we have witnessed a remarkable revolution not just in the outward design of automobiles but in the design qualities they express as icons of our age. We have moved from profligate luxury to responsive austerity.

Then you are separated from the others but still seated and going along with 100 seated people on a platform which is silently and misteriously guided thru swamp grass and fields of grazing, moving dinosaurs.

The propulsion system for these platforms was developed by our own EAA member John Bolger of Orinda, CA. The system is sometimes referred to as "Electric Powered Roadway Vehicle" or "Dual Mode Electric Transportation System". These platforms are driven by small (3 Hp.) motors and Delco #2000, 90 Amp. Hr. maintenance free batteries. The batteries are charged by John's magnetic induction system from an electrical conductor buried in the floor of the theater. There is about 3/4" air gap between the floor and a pickup steel plate with a coil underneath the platform, See Sketch. The batteries are charged while the vehicle is parked in the theater and then discharged as the vehicles are propelled, and electronically guided, around their route. This propulsion system has had no failures or replacements in six months of operation, zero maintenance. These batteries are being discharged about 4% of their capacity and have been thru about 6,500 cycles.

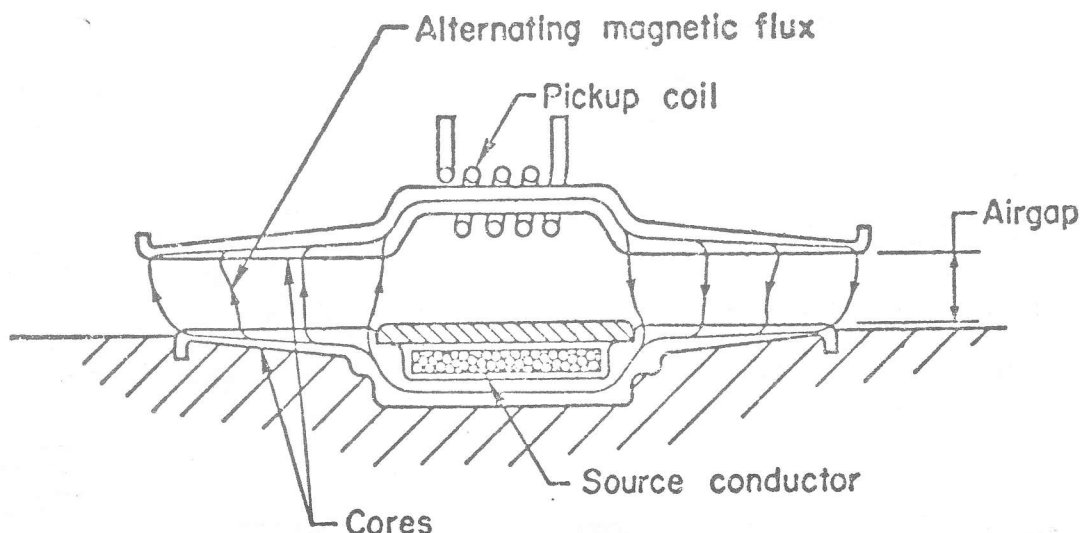
Solar power from the roof is utilized in this system.

At General Motors "World of Motion" you may be in for some more surprises. After a wonderful ride thru a historical and humorous presentation of transportation developments, you are shown the future as G.M. is designing it. The prime candidate as an alternate for the gasoline engine is a complex coal-fired gas turbine engine for passenger cars. But I was really surprised to see their Prototype Electric Commuter Car on display. They use nickel-zinc batteries to provide 140 volts. Car weight was shown as 2000 Kg. 20 Hp. electric motor is shown with an integral transmission. Acceleration is to 50 mph in 15 sec. The body is aluminum and composites. Range is 120 miles and top speed is 60 miles per hour. Now which do you think will be your passenger car of Tomorrow, a coal-fired gas turbine or an electric?

Disney's "Future World" is really electrified, as well as electrifying.

Prepared by

J. Newell



Coupling schematic.

THE PERFECT MOTOR ???

THE IDEAL MOTOR: Compound wound - 20 H.P. - welded comutator - 10 K, RPM test - 4K to 5K RPM @ 48 volts or 96 volts-Small and light. This motor is not manufactured. There IS NO MOTOR MADE OR DESIGNED JUST FOR THE ON ROAD ELECTRIC VEHICLE.

THE CM 77 AIRCRAFT GENERATOR/STARTER, comes closest to the ideal specs. This machine is almost indestructable! ie., 10,000RPM and over 1000 amps without failure, working up to 72 volts with no problems. Field current must not exceed 10 amps. Regenerative breaking is very simple.

SHUNT MOTORS: With a shunt motor the field voltage must be maximum at ALL times. There is absolutly NO advantage in varying the field on any shunt motor. This is the most common mistake I have seen. I personally would never drive any electric without regenerative breaking, mainly to protect the brakes from damage. The small cars we normally use do not have brakes designed to stop the extra 800 to 900 lbs of batteries.

POPULAR MOTORS IN COMMON USE.

BALDOR

10 HP, 96 volt - designed as a universal power source for stationary machines subject to mechanical breakdown, soldered comutator, sensitive to overspeed. Large, heavy.

PRESTOLITE

20 HP, 96 volts - series only - requires trick circuits for regeneration, subject to mechanical breakdown. Good size and weight. Designed for in-plant burden handling.

AIRCRAFT GENERATORS

This is the most popular, CM77, Cm76, EA40 or any 400 amp (300 amp. for lighter cars) 28 volts units, Works very well up to 72 volts. Small light and strong.

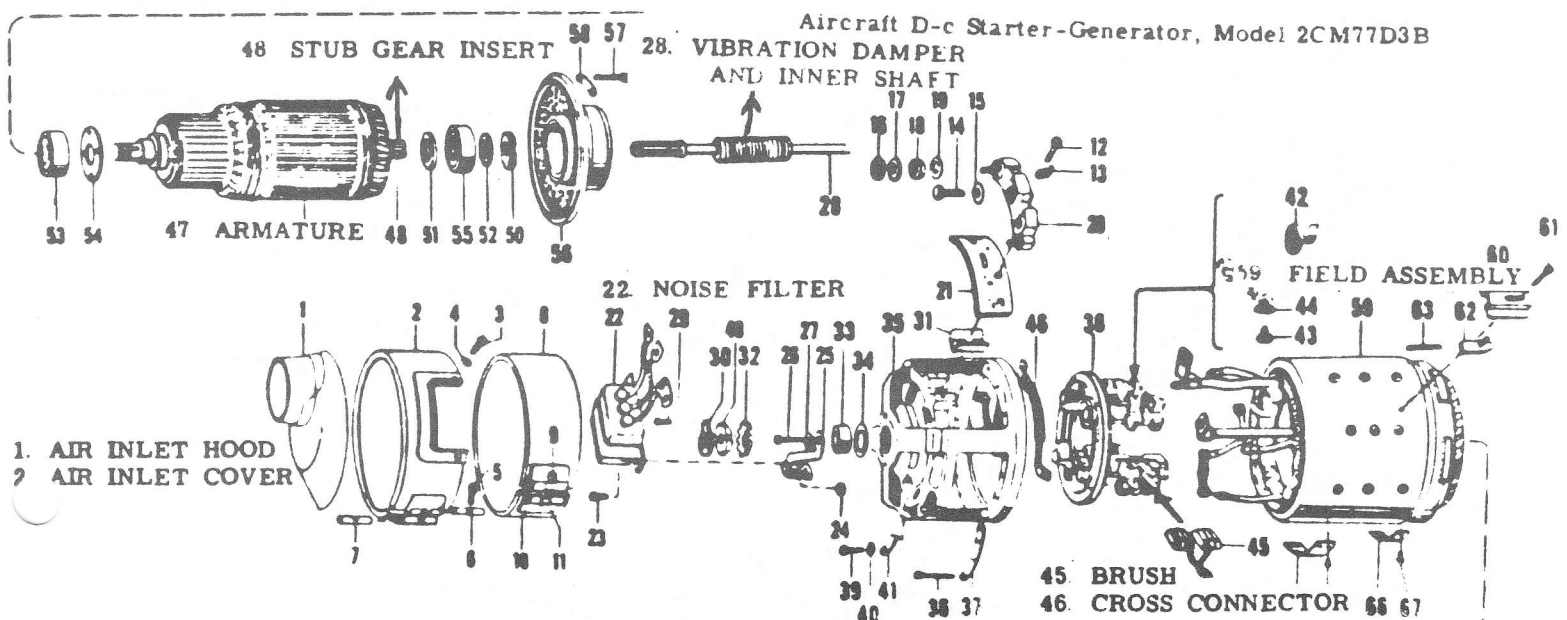
POWER: It takes 12 to 20 H.P. to drive a 2500 to 3000 lb car at 55 MPH.

BATTERY DRAIN: 15 HP = 96 volts = 11190 watts = 116.6 amps.

72 volts = 11190 watts = 155.4 amps

48 volts = 11190 watts = 233.1 amps.

I use 48 volts (min. for good speed) with 2 banks of batteries. Same drain as 96 volts with single string batteries. Good luck, Clarence Ellers.



1983

EV EXPO

MAY 21



SACRAMENTO CHAPTER will be holding the First Ever Efficiency Run on Saturday, May 21, at McClellan AFB. THE FIRST EVER will be held in conjunction with the Base Open House to honor Armed Forces Day.

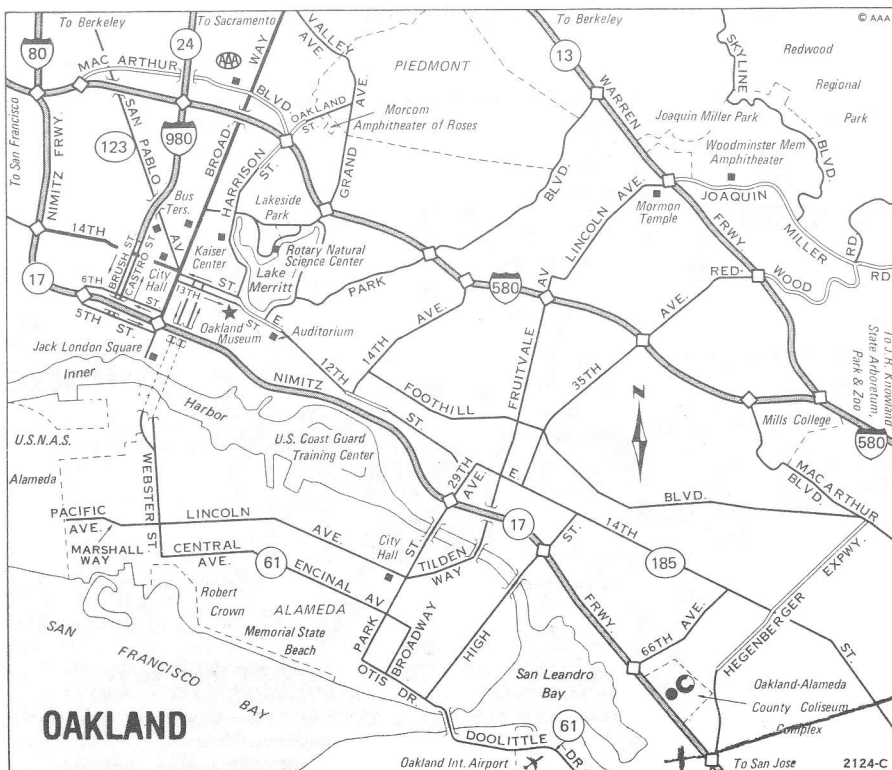
Visitors will be transported about the base in EVs. A Demonstration of maximum EV distance in typical use.

3 AWARDS will be given for DISTANCE TRAVELED.

AUGUST 13

EASTBAY CHAPTER RALLY will be held on August 13th at the Hyatt, in Oakland. Rally will start at 9:30 a.m. and will run for 5 hours. Get your cars ready. Awards will be handed out at the September 3 meeting. Call Chuck after 6 p.m. (415) 431-8179 for more information

ELECTRIC VEHICLE *Rally*



There are many EAA members that do not belong to a club. But they like to know what is going on especially in their area of the country.

SO

Keep the EAA Newsletter staff supplied with lots of YOUR CLUBS ACTIVITIES. If the CLUB NEWS does not fit on one page we will use two pages.

OR MORE

PHOENIX CHAPTER will hold the first Shopping Mall Show on June 16-19 at the Tri City Mall in Mesa. They need more cars for display. SIGN UP NOW. Commercials, Conversions or Golf Cars welcome. For more information call
RON JACKSON (602) 969-7258

SAN JOSE CHAPTER MEMBERS ATTENTION. Your next scheduled meeting will be May 14 same location, Pearl and Blossom Hill Road, at 10 a.m.

PENINSULA CHAPTER MEMBERS shall meet now at the usual time on the first Saturday in a new location - the DOWNSTAIRS ROOM OF SAN BRUNO LIBRARY, Angus Ave. West, and El Camino in San Bruno.

FOR SALE

'69 Toyota, Baldor Motor PMC Control
16 Trojan Batt. 96V Charger \$3,500/offer
J. Allison (209)952-7370

'72 RX-3 with 2CM76 Motor 10 Batts. -
Willey 7 Contr. \$1,500/offer. M LeBlanc
(904) 778-3792

(2) 400 A 30V Motors \$400 each/best offer
S.Echt, P. O. Box 225 Santa Cruz, Ca.
95061 (408) 423-3813 (days)

Clark 5.5Hp-36V Motor \$250 GE 9.4Hp-
36V motor \$350 - Charger with timer \$160
D. Shtaida (414)675-2579

1982 Renault Leopard used 350 miles
\$6,500. Cost new \$12,000 Chet Jones
(415) 939-2067

69VW SQBK 72V Baldor, PMC Contro. J250
Reliable \$2,500/offer (916)362-9428

Electric Road Runner 2 pass., 2 speed
Moped 30 mph. 25m on charge \$1,000
Ken Ekstrom (209) 733-2763

Electric SuperTrike 1 pass. 2 speed,
15 mph 35 m on charge \$200 Ken Ekstrom

2CM76 Motor -Generator Clean \$250/offer
R. Barline (415)526-6697

20 Current 19" T.V.s \$195 to \$295
Clarence Ellers (408) 296-8532

AA ELECTRACAR, INC. has reduced its business and moved to 1085 Tasman Dr. # 732, Sunnyvale, CA94086. For information on the Aquila, Electric Engine Kit, Batteries, etc., call Alfred Hardage at (408) 734-8385. Al will be handling the Alco batteries at \$65 each for six or more, delivered within a 50 mile radius. He will also provide a vehicle moving service for \$30 within a 30 mile radius.

ELECTRO AUTOMOTIVE presents the complete, efficient EV System, consisting of: Willey 9 Controller - The China Motor - Alco Batteries - and all necessary components for a complete conversion. For details call Mike Brown at (408) 438-3606.

ELECTRIC VEHICLES INC. Northern California EV Dealership offers YEAR END CLEARANCE

Jet 600 Minivan, new \$ 10,995
Jet 600 used 2K miles 8,995
Jet 600 22K miles \$5,995
Jet Electrica (Escort) demo 9K miles \$9,995
Jet Electrica 007 (Omni 024) demo \$5,995
Honda Civic Automatic, used \$5,995
EV Conversion Components: Prestolite
MTC 4001 DC Series Motors, new \$795
Transistor Speed Controllers EV1 - 82
400 Amps/up to 110V \$695 - Electric
Engine TM complete conversion unit
\$2,200 (EAA members discount.) Write
to EVI 2736 Winfield Dr., Mt. View, CA
94040 or call (415) 964-3974.

ADS must be into Bill Palmer by the 10th of the month. Small (1 or 2 items) \$5 each month. Add a bit more for larger ads, More on this later.

Announcing

INTERNATIONAL SOLAR-POWERED VEHICLE ASSOCIATION
WORLD'S FIRST

SOLAR POWERED ELECTRIC VEHICLE COMPETITION

AUSTRALIA
"Quiet Achiever"

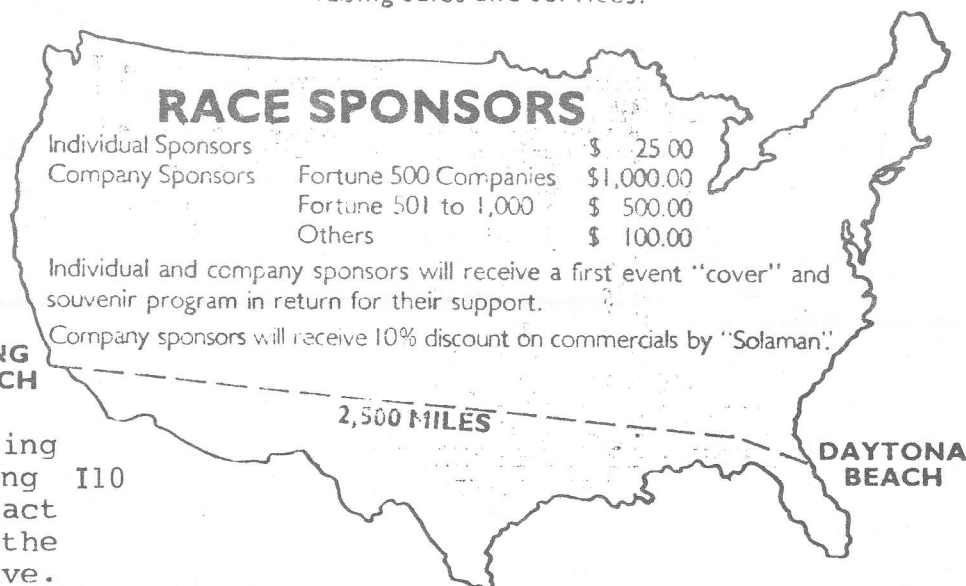
ACROSS THE UNITED STATES AUGUST 1983
233 UPLAND BLVD., LAS VEGAS, NV 89107

UNITED STATES
"Silent Challenger"

LONG BEACH, CALIFORNIA TO DAYTONA BEACH, FLORIDA

Your participation is invited!

The cost of staging this unique event will be through private sector support and fund raising sales and services.



NOTE!!!

Anyone willing to help along I10 please contact Mr Ruby at the address above.

FUND RAISING

"Solaman" solar rechargeable robot. "Solaman" will be programmed to autograph souvenir programs; give details on the vehicles, route, solar photovoltaics and commercials for sponsors;

Solar operated gifts including music boxes, (tunes -- choice: 'You Are My Sunshine', 'Here Comes The Sun', and 'Sunshine Of My Life'); bumper stickers, solar watches and clocks; t-shirts;

Souvenir programs; Other ideas welcomed.

COLLECTIBLES

"Covers" only or additional "covers"--North America \$2.00; overseas \$2.50 (be sure to provide addresses for additional covers);

Souvenir programs--\$5.00 (publishing date August 1, 1983);

Newsletter giving details on the "Silent Challenger"; race rules and route; "Solaman's" resume; and prices of solar gifts--\$2.00 (available March 15, 1983);

Advertising rates in the souvenir program and commercials by "Solaman"-- send stamped self-addressed envelope.

CLIP

Please Print or Type

ORDER FORM

Name _____

Amount Enclosed \$ _____

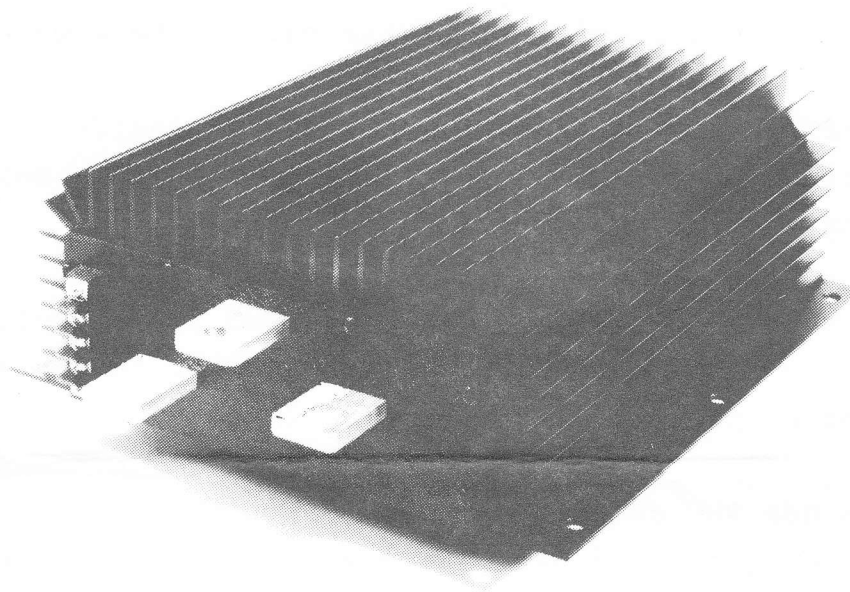
Address _____

For: _____

State _____ Zip _____

Official receipt will be issued for all orders. Make checks payable to Race Account SPVA

THE DCC 120 & DCC 100



transistorized controllers

SPECIFICATIONS

NOMINAL INPUT VOLTAGE	24 TO 120 VOLTS (100 VOLTS)
NOMINAL OUTPUT CURRENT	400 AMPERES (ADJUSTABLE)
FREQUENCY OF OPERATION	2 KHZ.
LOW POWER REQUIREMENTS	NO TAP OR AUXILIARY BATTERY REQUIRED
EXTERNAL POT REQUIREMENTS	5 KOHM
WEIGHT	14 LBS.
SIZE	9.0" x 10.5" x 3.5"

PMC Energy Systems, Inc. of Berkeley, California is proud to announce its latest development in pulse-width-modulated transistor controllers. The DCC 120 and DCC 100 offer a combination of features never before found in any motor controller. For example:

*Inconvenient and confusing battery taps for the low power circuitry have been eliminated - the low power circuitry runs directly off of the main battery pack.

*The controller is completely sealed inside a weathertight heatsink - no worries about dust or moisture affecting controller operation.

*A massive heatsink avoids the need for a cooling fan in many cases - mounting the controller in the air-stream often provides sufficient cooling.

*Unique PMC current limiting circuitry eliminates the bothersome squeal and hesitation which accompanies pulse-by-pulse current limiting found in most other controllers.

*Protection against starting at high throttle is built in - throttle must be at zero before controller will turn on.

*Overtemperature sensor reduces current and dissipation in the event of overheating - vehicle may still be driven but at a reduced current limit.

*Controller weighs only 14 lbs. and is extremely compact - only 9" x 10½" x 3½".

Write or call for prices and delivery. PMC Energy Systems, Inc. 1224 10th Street, Berkeley, California 94710
415 - 526 - 6697

ELECTRIC CAR SPEED CONTROL

AN OVERVIEW

CONTROL WHAT, WHY AND HOW:

Our prime mover now is a motor which runs on electricity and not a combustion engine running on fuel and air. So we can't use the old throttle valve connected to the accelerator pedal to control the flow of electricity to the motor. The engine's throttle valve really controlled car speed by changing the torque output of the engine by letting in more or less fuel and air. What we need for the electric car is a device we can connect to the accelerator pedal which will control the torque output of the motor.

CONTROLLING TORQUE:

A look at the fundamental motor equation for torque will show what is required to control torque.

$$T = K_t \times F \times I_a$$

The equation says simply that torque is equal to the torque constant (fixed by the motor design) times field strength (field current for wound fields) times armature current. So we can control torque by varying either field strength or armature current or both. In a series motor, since the same current flows through both field and armature, you do change both. In a shunt motor they can be changed independently.

CONTROLLING ARMATURE CURRENT:

The current equations:

$$I_a = V - (K_g \times F \times N) / R$$

The term: $(K_g F N)$ is called the generation or back-emf term. It says that back-emf is proportional to the generation constant K_g , which is fixed by the motor design, times field strength times motor speed. So, the current equation says that armature current is determined by the difference between applied voltage and back-emf divided by the armature resistance. Since back-emf is zero when speed is zero and since armature resistance is a small fraction of an Ohm, the motor is practically a short circuit until its speed is significant enough for back-emf to limit current. So, to prevent excessively high currents at starting, voltage must start low and be increased gradually as speed increases.

The more rapidly voltage is changed, compared to speed change, the greater will be armature current and torque.

REGENERATIVE BRAKING:

Regenerative braking is using the motor as a generator to convert the kinetic energy of car motion or potential energy going downhill into electric energy and pumping it back into the batteries.

Imagine that you are cruising along down a slight grade which is

just steep enough to overcome propulsion loads. No motor torque is needed to keep the car moving at constant speed. The ammeter reads zero with voltage applied to the motor. In this condition you are at the "balance point" between motoring and generating. In the current equation, back-emf equals applied voltage. If back-emf is increased by increasing field strength or by increased speed, possibly by the down-grade getting steeper, or if applied voltage is decreased, or any combination of these, so that back-emf is greater than applied voltage, then the numerator becomes negative which makes the current "negative". That means the current flow changes direction. In the torque equation, a negative current causes the torque to be negative which means that it reverses to retard the car instead of accelerating it.

With torque reversed the car is driving the motor as a generator. The generated current and retarding torque are proportional to the amount by which the back-emf is greater than the applied voltage. Retarding torque can be as great as accelerating torque at speeds down to a few miles per hour, if the field is strong and battery voltage is low. Regenerative braking works best with control systems in which the batteries can be switched to parallel connection so that voltage is minimum and the current is divided into as many parallel paths as possible.

Shunt-wound motors operate equally well as generators. With series motors it is difficult, but not impossible, to reverse armature current without reversing the field and to control field strength separately from armature current.

CONTROLLING VOLTAGE:

We know now that it's voltage applied to the motor which we must control and we know why. So, let's examine several ways that we can do it.

1. VARY NUMBER OF CELLS IN SERIES:

We all know that batteries are essentially constant voltage devices. We know that the more battery cells we connect in series, the greater the terminal voltage will be. So, if we have a convenient way to change battery connections while we drive, we can control speed by varying the number of batteries in series with the motor. Figure 1. shows batteries connected in series.

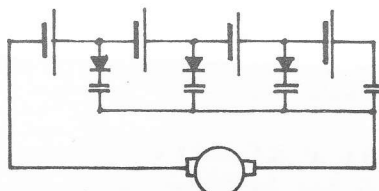


FIGURE 1. TAPPED BATTERY

by BILL PALMER

Several contactors allow us to tap the battery string at various places putting various numbers of batteries in series with the motor. Balanced use of battery energy and smoothness of control may be less than we would like but this control method is simple and inexpensive. The diodes make it unnecessary to interlock the contactors to prevent more than one being closed at a time which, without the diodes, would short-circuit one or more batteries. The diodes also prevent reverse current so regenerative braking can only be used with the highest voltage connection.

Figure 2. shows a method of switching the connections between groups of batteries to either parallel or series using double-throw contactors.

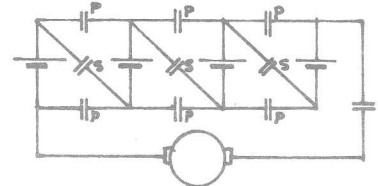


FIGURE 2. SERIES/PARALLEL

In one direction the contacts connect the batteries in parallel with the "P" contacts and the other connects them in series with the "S" contacts. This method provides balanced use of battery energy in most steps but acceleration smoothness suffers because of step changes of voltage as in the tapped battery method. The "P" contacts can be replaced with diodes so single-throw, single pole contactors can be used but the price is some voltage drop in the diodes and loss of regenerative braking except in the highest voltage connection.

VARY "LOST" VOLTAGE:

Figure 3. shows a resistor between the battery and motor with several contactors arranged to "short-out" sections of the resistor to vary the effective resistance.

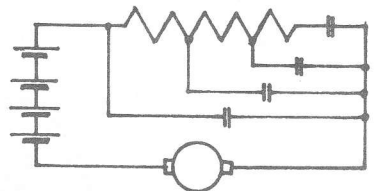


FIGURE 3. RESISTANCE

We know from Ohm's Law, $V = I \times R$, that current flowing through a resistance develops a voltage which opposes the current flow and, in effect, subtracts from the applied voltage. With the resistor in the circuit between the battery and the motor any voltage "lost" in the resistor is subtracted from the battery voltage so the motor only

continued —>

Control continued:

receives the difference. This is another way to limit motor starting and accelerating current. It's simple and inexpensive but the lost voltage times the current which generates it equals watts which is power lost as heat in the resistor and not available to the motor to move the car.

VARY TIME VOLTAGE IS APPLIED:

Figure 4. shows what looks like a simple switch in the circuit between the battery and the motor.

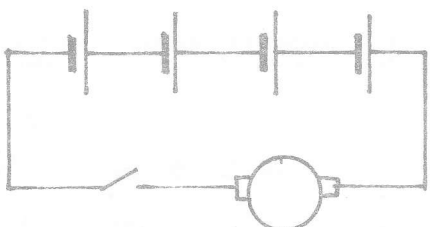


FIGURE 4. SOLID-STATE

It is a switch but it's not simple. It is either a mechanical or a solid-state switch such as a thyristor or transistor. It varies the effective voltage at the motor by opening and closing the circuit repetitively so voltage is "chopped"

and applied to the motor in pulses. The effective voltage seen by the motor is proportional to the average of pulse ON-time and OFF-time. When the on-time is short compared to the off-time, the average voltage applied to the motor is low. If ON and OFF times are equal effective voltage is half the battery voltage. When the pulses occur quite rapidly the car's inertia and a freewheeling current loop around the motor combine to dampen the torque pulses so they are not noticeable, but some choppers whine.

SUMMARY AND PREDICTION:

This overview covered the what, why and how of electric car speed controls. Our plan is to cover hardware in subsequent articles in the near future. If you have any questions about this article or about anything pertaining to electric cars, or suggestions for future articles, please send them to me for the editorial staff:

Bill Palmer
44 Dior Terrace
Los Altos, CA 94022.

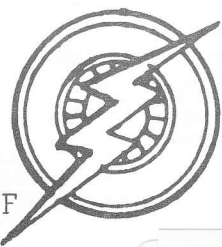


CORRECTION: Heavy editing on the articles -- THE PERFECT MOTOR FOR EVs??? and GENERAL ELECTRIC TYPES 2 CM76/77 STARTER GENERATORS -- resulted in miss information. THE PERFECT MOTOR FOR EVs??? is being reprinted as written. Exception: FLASH FLASH!! from Chuck Huntley, BALDOR MOTORS ARE NOW BEING WELDED. Thanks Chuck.

THE NEW EDITORIAL STAFF

Is working for a NEW AND BETTER NEWSLETTER. Send in your Personel and Club news , articles, comments, etc. to Bill Palmer by the 10th of the month.

PUBLISHER
Walter Laskie
EDITORIAL STAFF
John Newell
Paul Brash
Clarence Ellers
Bill Palmer
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