

Electric

Auto



NEWS

June 1983

Association

Vol. XV No. 6

MEMBERSHIP DRIVE

THE LARGER OUR NUMBERS THE LOUDER OUR VOICE PLEASE CALL THREE PEOPLE+
AND PASS THE INCLOSED APPLICATION TO AN INTERESTED PARTY

TRANSPORTATION

21st Century

STYLE

California Legislature is seriously considering electric vehicle transportation systems. Assembly Bill No. 1456 is the vehicle and we will need everybody's help with this legislation. We need professional, technical, and financial assistance.

The first section of the Bill reads: "The Legislature recognizes that the continued use of internal combustion vehicles poses a serious risk to public health, welfare, and security because of air pollution and dependence upon foreign oil. The Legislature further recognizes the demonstrated potential of various alternative transportation forms, such as electric vehicles, and wishes to encourage through this act the development of such transportation modes. Therefore, the Legislature hereby establishes a California Alternative Transportation Steering Committee (CATSC) which shall oversee and direct a California Alternative Transportation System Project (CATSP) to research and develop a statewide plan for implementation of a non-polluting reduced energy dependent California transportation system."

This is the beginning of the "BIG PUSH" we have been awaiting! Our Assemblyman, Bill Leonard, from the Los Angeles area is really serious about this legislation and has taken the initiative required to get a hearing before the Transportation Committee.

The Sacramento Chapter Secretary, Loren Lafferty was present. He reports that the Bill was sent to an interim hearing for further study. We have been offered an opportunity to testify at this meeting and in the meantime to provide material which our supportive Assemblyman would find useful.

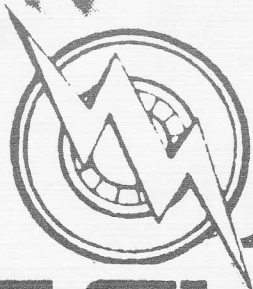
Now scratch your head and come forth with some constructive and innovative ideas for us to pass on to become a part of this proposed new law. Please mail them to 1249 Lane, Belmont, CA 94002.

Following the hearing, a Los Angeles Times reporter has contacted our John Bolger for more information about the "Roadway Powered Electric Vehicles" and his system to provide power to vehicles such as ours. The reporter, Allan Parachini and photographer, Rick Meyer seem to understand our vehicle potentials, so look for some good, positive reports soon.

PLAN ON IT

NOTICE: Contra Costa July Meeting on July 9 (second week) is a joint meeting with the East Bay Chapter. They will visit Naval Weapons Station in Concord and see an Electric Car Demonstration Fleet. (Vehicles not Ships)

It is required that you call MAX ROSENSTEIN (415)229-3469 to register your name. Please call prior to Mid-June.



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8
3

THE FUTURE IS HERE.

SEPT 10 11

ELEVENTH ANNUAL INTERNATIONAL

REWARD

FOR THE CAR FROM THE FARTHEST DISTANCE !!!!!
REGISTER AND COMPLETE ONE LAP TO QUALIFY



\$100.00-----1st. PRIZE

\$75.00-----2nd. PRIZE

\$50.00-----3rd. PRIZE

SYMPOSIUM

Sunnyvale, California

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Pat Hardage, 1085 Tasman Dr. # 732 Sunnyvale, Ca. 94086

*Rallye
Event*

COMMERCIAL ENTRIES--gain exposure to hundreds of people actually interested in electric vehicles, plus the media coverage. Compare your car(s) with electrics designed and built by top silicon valley engineers as well as the talents of our 2000 + membership.

CLUBS, ASSOCIATIONS AND OTHERS Participate in an important and interesting learning experience. Start NOW to raise money to send one or more cars to our Rally. Hold a competition to decide which car will be entered, or build a club car for entry. Ask business people and suppliers for donations, hold raffles at club meetings. Sponsor a picnic, dance or other fun money raising affair. YOU CAN DO IT. APPOINT A COMMITTEE AND START NOW.

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EV Marketplace

ELECTRO AUTOMOTIVE

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.

* * * * *

Switching Power Transistors
 Lambda PMD20K150 150 Volts
 14 Amps \$4.00 each - New
 Ric (408) 356-0289

* * * * *

Adapter Plate, Cast Alum. w/bearings and rabbets for GE2CM76 and J&H G-29 (&Baldor) Mfg'd by Bill Palmer
 (Cost \$287.00) Sell \$195.00
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(5) GE panel Meters, square 4 1/2" 0-15V
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 100 amp. shunt \$25 each or all for \$100.
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* * * * *

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Northern Calif. EV Dealership **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 Controller EVI-82 400F 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.

BREWER ASSOCIATES

Exclusive producer of Willey Solid State Controller Kits (to 450A & 120v), designed for easy assembly and big savings, with top quality components and manual. We also stock blowers, contactors, meters, test eqpt., fuses, etc. Write or phone for our catalog:

21511 Deerpath Lane (213) 456-6236
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'72 Triumph Convertible
 72 Volt Prestolite Motor
 PMC, Controller
 12/72 Volt Lester Charger
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 Bill Kreipke (916) 988-3166

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We have reduced our business and moved to 1085 Tasman Dr. # 732, Sunnyvale Ca. 94086. 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.

 ADS must be received with payment by the 10th of the month, for the following month's issue. Ad rate is \$5 each half column inch. (1/2" high by 3 1/2 wide). 2"+ \$5.00 inch
 Mail to EAA 1249 Lane St. Belmont Ca. 94002.

by FRANK G.

WILLEY,

ELECTRONIC SPEED

PHOENIX

CHAPTER, E.A.

CONTROLLERS

In the April 1983 Newsletter, Bill Palmer described various types of electric vehicle control systems. The most sophisticated of these is the "chopper" controller.

WHAT IS A CHOPPER CONTROLLER?

A "chopper" controller is a mechanical or electronic switch which opens and closes rapidly, to vary the average voltage applied to the electric vehicle motor, by varying the ON-to-OFF time of the switch. Its proper name is pulse-width-modulator (PWM).

The mechanical type has a motor driven commutator, contacted by one fixed and one movable carbon brush. The mechanical chopper is not in wide use because of high wear rate and driving power requirement.

Electronic solid-state choppers employ either silicon controlled rectifiers (SCRs) or power transistors as the power switch. These switches can open or close in millionths of a second (microseconds) and hence are commonly operated at rates of 400 to 4000 closures per second. Continuously variable pulse width results in completely smooth acceleration, and permits running at any intermediate speed. Until the 1970s, SCRs were cheaper than power transistors, which accounts for their earlier use in solid-state controllers. Transistor controllers now available to the electric car builder are generally lighter in weight than available SCR controllers.

WHY USE A PWM CONTROLLER?

Referring to Palmer's article, battery-switching (ladder or series-parallel) controllers provide only certain fixed voltages to the motor, such as 12, 24, 36, 48 volts. Each step up produces a jerk, and each step produces a single cruise speed. System efficiency is good. Unequal use of battery units may create charging problems.

Resistance controllers also have fixed steps. Switching jerks may be less than for battery switching. The resistors, used in all but the top step, waste energy of resistor heating, reducing overall vehicle range per battery charge. Unless resistors are ruggedly designed, cruising on a resistance step is not permissible due to danger of resistor burnout. Thus, only one cruise speed may be permissible, a disadvantage in road traffic.

Resistance and series-parallel modes can be combined, as in the older streetcars with two cruise speeds, reducing the disadvantages of both.

The electronic PWM controller produces no jerks and discharges all batteries equally. The efficiency is typically 98 to 99% at cruise current and 94 to 97% at maximum current for 60 to 120 volt systems. Current limiting is an added advantage option.

SPARKLESS CHOPPING

Anyone who has opened a knife switch supplying current to an inductive (magnetic) device has seen the hot spark that burns the switch points. The inductance of the motor tries to maintain the current flow while opening of the switch tries to stop it. If you were to place one hand on each switch contact as you open the switch you could be dangerously shocked.

To solve this problem, a rectifier diode (a device which passes current in only one direction) is connected across the motor as shown in Fig. 1. This is sometimes called the "clamping" or "freewheeling" diode. When the switch is closed, current I_1 flows through the motor and no current flows through the diode. When the switch opens, the diode provides a return path I_2 for this current, relieving the switch of having to fight the motor inductance.

If the ratio (inductance/resistance) of the motor is sufficient, the current I_2 will decrease very little until the switch again closes. This is usually the case with series motors; shunt motors may require an inductor in series with the armature. Thus the continuous motor current may considerably exceed the average pulsed battery current, as shown by meters. When the switch is closed 100% of the time, motor and battery currents are equal.

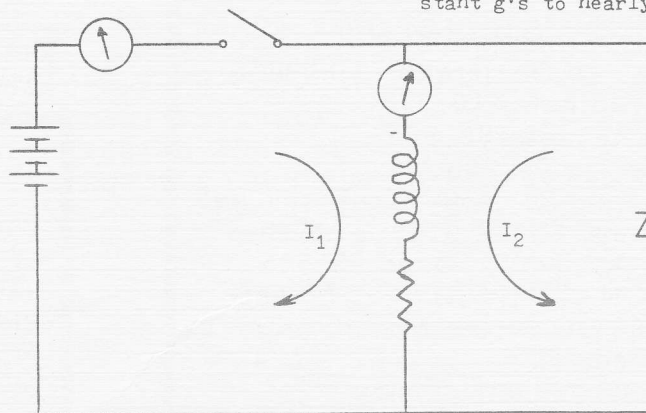


FIGURE 1. CHOPPER CIRCUIT

COMPONENTS OF A SOLID-STATE CONTROLLER (Fig. 2)

1. Pulse Width Modulator (PWM)

The PWM consists of a sawtooth voltage generator, and a comparator which puts out a pulse during the period that the input control voltage exceeds the sawtooth voltage. The higher the control voltage, the wider the output pulse. Formerly requiring many transistors and parts, the PWM is now built in a single integrated circuit.

2. Amplifier

The amplifier is an electronic switch which can switch hundreds of amperes, in response to the output pulses of the PWM.

An SCR amplifier contains at least 2 SCRs. Because an SCR cannot turn itself off, typically a second SCR and capacitor are used to help the first SCR turn off.

A transistor amplifier commonly consists of a "driver" stage, followed by a final stage having a number of transistors in parallel. The most economical transistors available today are in the range of 20 to 200 amperes rating, hence several must be paralleled to obtain the full controller rating. Because of transistor manufacturing variations, there is need to assure equal current between them. This can be done by matching resistors in the collector or emitter circuits, with some power loss. A circuit invented by F. G. Willey in 1968 has matching resistors in the base circuit for lower losses.

OPTIONAL AND SAFETY COMPONENTS

3. Current Limit Feedback (CLF)

This useful feature is found only in electronic controllers. If the motor current can never exceed a design limit, battery range is extended, passenger comfort is enhanced, cable and batteries overheat less, and part breakage due to excess motor torque is prevented. With CLF one can jam the pedal to the floor and the vehicle will accelerate at constant g's to nearly cruise speed.

When motor current exceeds the set limit, the CLF logic inhibits the further increase of PWM pulsewidth. (See Fig. 2) The Willey circuit mentioned recognizes the sudden collector voltage rise upon excessive current. Another method detects the voltage drop across a resistance in the armature circuit when current exceeds the limit.

CONTROLLERS CONT'D.

4. Overtemperature Protection

This feature will prevent controller damage due, for instance, to heavy use on a hot summer day. This protection should reduce power only; cutting off power could be disastrous traffic.

5. Regeneration

Regeneration means use of the motor as a generator to return to the batteries some of the energy of the moving vehicle instead of wasting this energy in brakes as heat, either to slow it down or to restrain speed on a downgrade. Regeneration is of little value on long level runs with few stops. Its value is greatest when frequent stops are made from high speed, or when operating in hilly areas.

Regeneration is more easily done with a shunt wound motor. When a downgrade speeds the motor above its "no-load" speed, it generates a voltage higher than that of the battery and sends current back into the battery. This current causes a decelerating torque which restrains the speed of the vehicle. A "reversed" diode is connected across the controller to allow the regeneration current to bypass the controller (Fig. 3).

Braking the vehicle down to low speed requires additional controller circuits. One method switches the batteries in parallel and controls shunt field current to vary braking (see Fig. 4). Another method (Fig. 5) periodically short circuits the armature and a series inductance; each time the short is opened, the inductance forces a pulse of current into the battery.

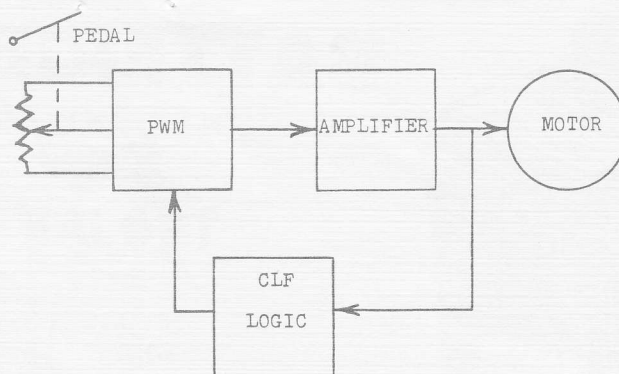


FIGURE 2. PWM CONTROLLER COMPONENTS

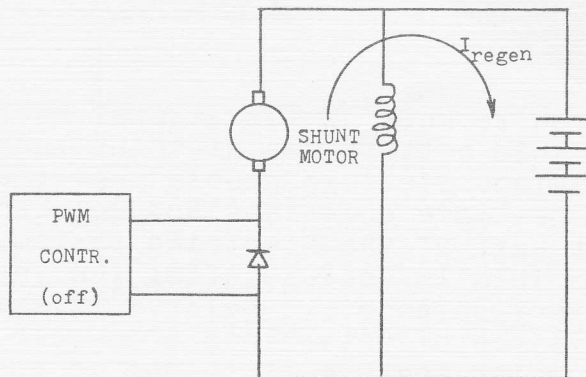


FIGURE 3. DOWNHILL REGENERATION

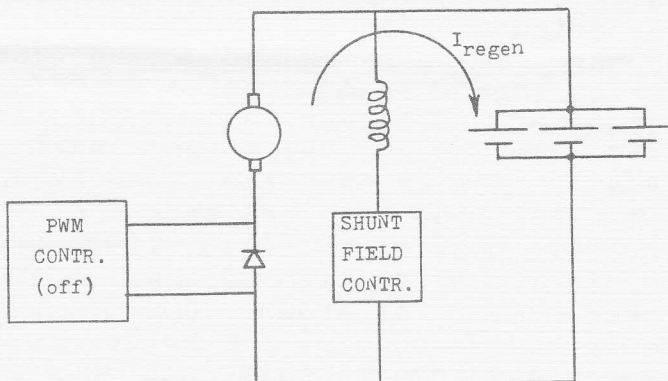


FIGURE 4. BRAKING REGENERATION I

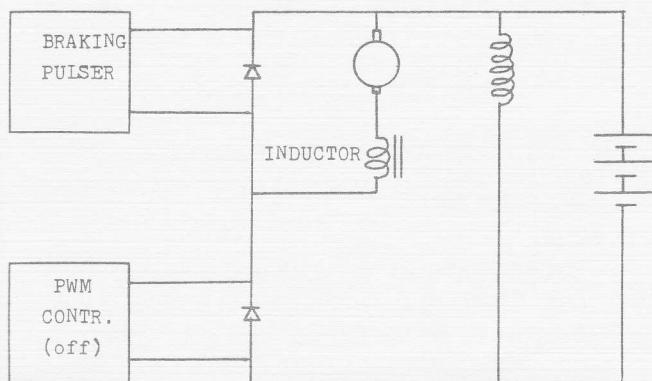


FIGURE 5. BRAKING REGENERATION II

CONCLUSION

The electronic PWM controller provides a smooth, efficient means of controlling speed and acceleration of an electric vehicle. Desirable features of current-limiting, regeneration, and safety are available. Cost and weight of electronic controllers have been greatly reduced in the last decade.

Of the 52 cars entered in the Sunnysvale EAA Rally in September 1982 for which data is available, 60% employed transistor PWM controllers. 4% employed SCRs, and 36% were voltage switching systems.

Frank G. Willey
9722 Lindgren Ave.
Sun City, AZ 85373

AFTER THAT STORMY WINTER OF '82-'83
--WE CAN SMILE

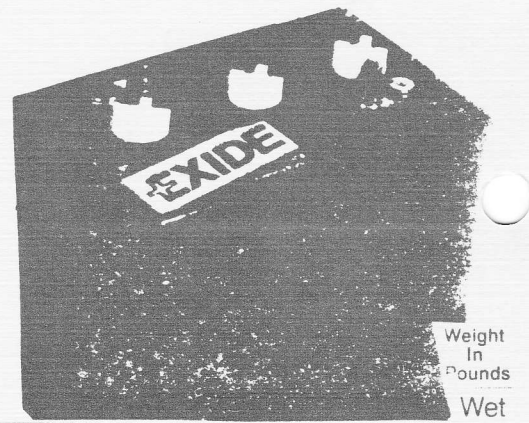
The biggest single power outage of Northern and Central California occurred this Winter. Two thirds of PG&E customers were without power. Many powerline crew members gave up their Christmas holidays in order to restore service. A Santa Clara Chapter member says he simply connected his electric car batteries of car into his home during the blackout. For lights and tools this is the greatest but be careful about using it to cool your beer or to watch Archie Bunker on TV.

BATTERIES

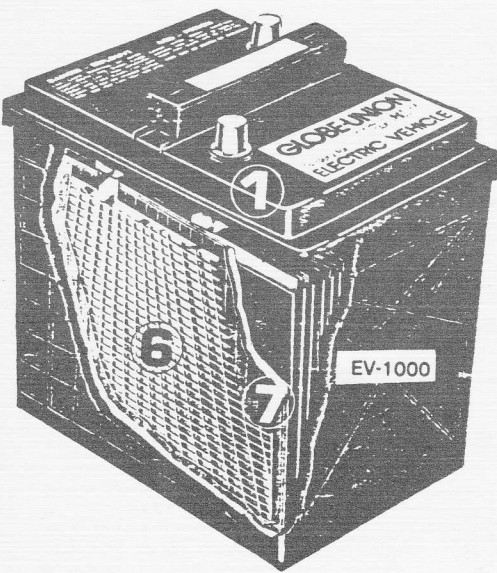


T-135 | 73
J-250W | 75

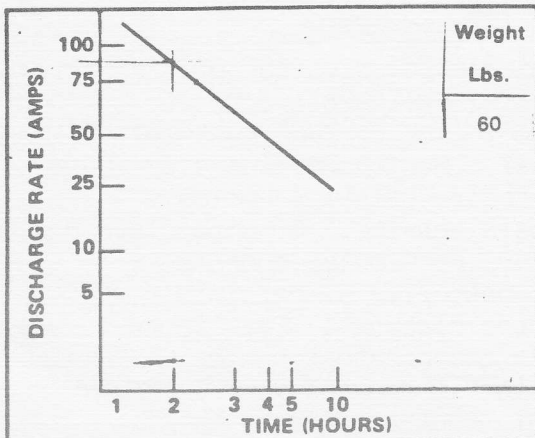
Alco



XPV-23	6	125 min.	10 ³ / ₈	7 ³ / ₁₆	11 ¹¹ / ₃₂	65.5
EV-106	6	100 min.	10 ³ / ₈	7 ³ / ₁₆	11 ¹¹ / ₃₂	65.5



If you're waiting for a super battery, forget it! The lead acid battery has given us ranges of 60 to 100 miles of urban driving. This is double what the average driver does in one day. We get more questions and more answers about batteries than any other part of the electrics system. Most of the answers differ greatly. This is because after 100 years the battery is still not an exact science. I believe this is because anytime you immerse a piece of metal into a caustic acid, no one knows the exact reaction because it seldom is the same. We put a man on the moon, developed computers that perform miracles, but the big technical breakthrough on batteries is to turn the plates around end to end rather than side to side. 30% more plate area therefore 30% more capacity. Experience of others and good record-keeping are the only weapons we have for choosing and caring for our batteries. The three batteries shown above have the best records in golf carts. Trojan, one of the oldest, has an outstanding record for durability. Bruce McCaskie won our rally four years in a row with the same set of 244's. Now we have the Globe EV1000. Two cars made almost 100 miles in 1981, the same two cars and same EV1000's made 118 miles in 1982. How many? The EV1000 cars had 16 and 20 batteries. Bruce did 127 miles with 20 new Trojan T135's - looks like 16 is the best number for around 3000 lbs total weight. Anybody with an EV should have a copy of the battery service manual by the Battery Council International - ask your dealer. After 10 years I finally found a reading that seems to mean something. The on charge (10 amp aprox.) voltage should come to 2.5 volts per cell. When fully charged, you cannot reach this voltage, you have one or more bad cells. Remember, 2 batteries in parallel count as 3 cells.



EV-1000

Keep vehicle batteries clean and free of acid spillage, dirt and grime — wash batteries with a stiff, non-metallic bristle brush using water and bicarbonate of soda. Rinse with water.

Use Petroleum Jelly
On ALL Terminals

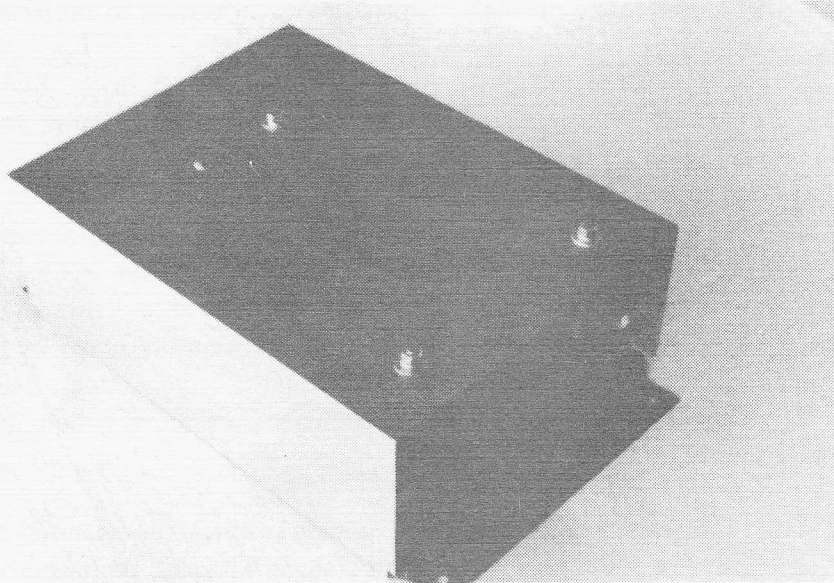
NOTICE:
EV1000 Program on
HOLD Check with
Mr Wilson at
Globe

Charles Ellers

Batteries should be recharged after each day's use. Charging between trips is advisable if it is feasible to do so. Do not take your vehicle out unless the batteries are in a good state of charge.

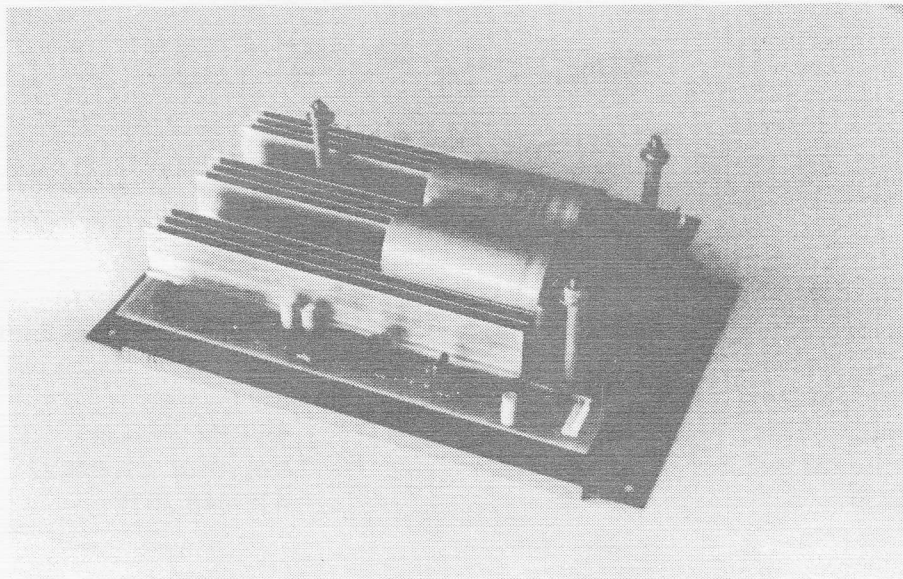
SPECIFIC GRAVITY	STATE OF CHARGE
1.260 Sp. Gr. to 1.280 Sp. Gr.	100% Charged
1.230 Sp. Gr. to 1.250 Sp. Gr.	75% Charged
1.200 Sp. Gr. to 1.220 Sp. Gr.	50% Charged
1.170 Sp. Gr. to 1.190 Sp. Gr.	25% Charged
1.140 Sp. Gr. to 1.160 Sp. Gr.	Very little useful capacity
1.110 Sp. Gr. to 1.130 Sp. Gr.	Discharged

WILLEY MODEL 9 SOLID STATE ELECTRIC CAR CONTROLLER



MODEL 9 is the latest Willey Solid state Controller, produced since 1977. It is available complete, or as a full kit of parts with construction manual for the serious amateur electric car builder, in ratings up to 450 amperes, at 24 to 120 volts. Models are also available with shunt field control for shunt or compound motors, with provision for regenerative braking.

The clean construction of the Model 9 Controller is seen in the photos. The mechanical structure is a single heat sink mounted on a steel base. A single heavy printed circuit board provides all wiring within the controller. Weight is 12 lb. Case size is 13½L x 10W x 5H, not including feet or fan.



The **WILLEY MODEL 9 CONTROLLER** provides **SMOOTH CONTROL** by continuously variable armature voltage from 0 to 100%, using pulse width modulation at 4000 pulses per second.

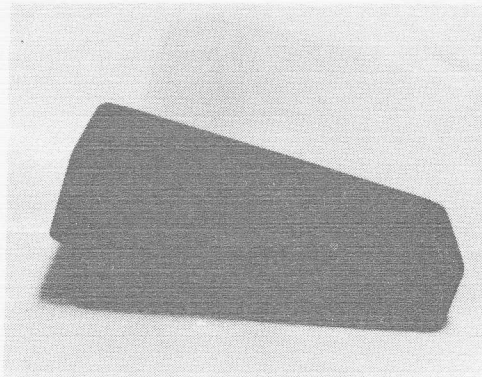
HIGH EFFICIENCY d.c. transformer action converts battery high voltage and low current to motor low voltage and high current.

CURRENT LIMIT feedback prevents damage and overheating to batteries, cables, controller, and motor.

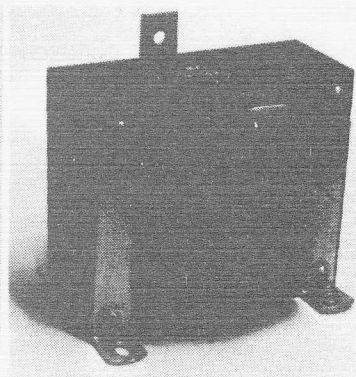
OVERALL EFFICIENCY of controller is typically over 98% at cruise and 95% at maximum power.

INSTALLATION is simple for either grounded or ground-isolated power systems. Under 3 amperes at 12 volts supplies all logic and driver stages. A single 5000 ohm potentiometer, available as a footpedal assembly, controls armature current. Applications requiring variable shunt field excitation require one additional potentiometer. Cooling is by external fan, either via 2" diam. duct, or mounted on the cover. Certain shunt motors with insufficient armature circuit inductance require a series inductor.

AUTOMATIC THERMAL PROTECTION reduces output power if controller overheats, and restores full power when temperature falls. A circuit is provided for dashboard indication of controller temperature.



Footpedal Assembly



Series Inductor

Available as complete kits:

Brewer Associates
21511 Deerpark Lane
Malibu, California 90265
213-456-6236

Available as complete controllers:

Bill Palmer
44 Dior Terrace
Los Altos, CA 94022
415-948-7677

HOW FAR CAN THEY GO (on one full charge) ???

This simple question is always one of the first asked of the electric car owner by the curious public and media when discussing electric cars. The answer, unlike the question, is complex because it depends on so many variables. Fortunately it can be intelligently answered in a non-technical manner by simply considering only three major factors (despite the fact that each factor is determined and/or affected by several other variables) as summarized below.

(1) OVERALL SYSTEM EFFICIENCY

total vehicle weight, battery type and total voltage, transmission/drive train type and gear ratio, motor, control system, tire type and inflation, inter-connecting component losses, frontal cross-sectional area.

(2) AVAILABLE BATTERY CAPACITY

age, temperature, discharge rate.

(3) DRIVING CONDITIONS

road terrain, acceleration, speed, number of stops/starts, aerodynamic drag.

Notice that Item 1 above is fixed for any given vehicle (whether powered by gasoline, diesel, steam, etc.), yet Items 2 and 3 vary each time the vehicle is driven. Therefore, the range that can be expected for any particular electric car will be primarily determined by the amount of available battery capacity and the driving conditions to which it is subjected.

Given an inefficient system (incorporating older, low-capacity batteries in a low voltage/high current configuration along with under-inflated tires) that is driven over numerous hills, with many stops and "jack rabbit" starts on a cold day: you would be lucky to see the end of only 15 miles. Conversely our Electric Auto Association has more than one efficient electric car with range capacity, under

normal driving conditions, in excess of 100 miles.

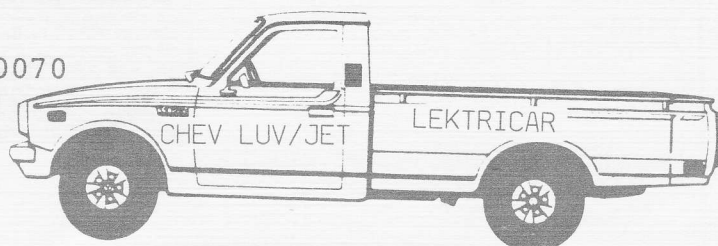
The average mileage logged-in at our 1981 EAA Rally by the top 24 cars was 66 miles, ranging from a low of 42 to a high of over 100 miles. Considering that over 90% of our daily driving trips in the United States are for total distances of less than 25 miles, the above figures prove that electric cars are "more than adequate" as a viable alternate energy form for transportation. They should be considered and discussed with respect to the contribution they are currently making (both by industry and public use), not as a replacement of the IC powered car, but as a valuable supplement.

FOOTNOTE: the average person on the street nowadays blames the battery for not giving the electric car the range (of 300 miles he NEEDS) and speed (of 70 MPH he NEEDS). Be tolerant of his ignorance when trying to educate him on the subject. 66 mile range may not sound too impressive, until you really consider how much is actually needed -- a 5 mile range is enough if your need is for only 4!! Patience my son, as we will overcome in the end.

By Bill Williams

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SUPER OFFER \$1995.00ea.

1981 Lektricar & Jet "Luvs" "As Is" Nev or Fla.
Less than 4000 miles on any vehicle
Call 312-394-8669 for information or
Write P.O.Box 136, Prospect Hghts, IL 60070



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WORKING ELECTRIC VW.

Deluxe Kaylor Kit, 12 batteries, towbar charger, etc. cost \$2500 steal for \$940/
OFFER. Letha P. Slagle Houston, TX.
Call eves. (713) 496-0413

ELECTRIC MOTORS
10HP 72 VDC \$500.
Bob Pawlik
6216 Westminster Dr.
Parma, OH 44129

Hybrid Electric-Datsun '71
Yamaha Engine with Generator
EA40 Drive Motor-(10) Batts
\$4,900/offer-S. Shigematsu
(415) 435-2726

Bookshelf

STEP-BY-STEP CONVERSION MANUAL _ By Clarence Ellers. Complete instructions on conversion of gas cars to electric. Simple method saves hundreds of dollars. Also information on parts and where to get them. Send for summary to Clarence Ellers, P. O. Box 2781, Santa Clara, Ca 95055

Guide to Electric Auto Conversion - Fourth Edition. A clearly written 76 page conversion Manual with an emphasis on practical techniques, using latest technology. Plans include several PROVEN diagrams and Schematics, as well as a comprehensive Parts Procurement Directory. Separate Chapters thoroughly cover Expected Conversion Cost/Performance, Electric Motors, Adaptor Plates, Controllers, Batteries, Chargers, Maintenance, System Test/Integration, Safety and wiring capacity. A real bargain for only \$19.95 from Bill Williams, Dept. EAAN, Box 1548, Cupertino, Ca. 95015

THIS MONTH

DENVER EV EXPO

(303)442-6566 ——— 9 — 12

HAYWARD (East Bay)

(415)431-8179 aft. 6pm ——— 11

EVENT

MESA (Phoenix)

(602)969-7258 ——— 16 — 19

THE NEW EDITORIAL STAFF

Is working for a NEW AND BETTER NEWSLETTER. Send in your Personel and Club news articles, comments, etc. All correspondence to address below

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Association

NEWS

JUNE 1983

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