Fox Valley Electric Auto Association
1522 Clinton Place
River Forest, IL 60305-1208

Address Correction Requested

NEXT MEETING: **Friday, August 21 at *7:00* PM in Room K-161 at The College of Dupage SW Corner of 22nd Street & Lambert Road in Glen Ellen.**

DISCUSSION TOPICS - 1. Inspection of Fred Kitch's Ford Ranger at 7-7:30PM 2. Further consideration of Ranger Donation Offer 3. "Ask The Fox" continued discussion of battery chargers and their application.

MEMBERSHIP INFORMATION

Any person interested in electric cars is welcome to join the FVEAA. The cost for a full year's dues is $20 which will entitle the member to receive our monthly Newsletter that contains useful information about electric car components, construction, policies and events. Dues for new members joining in August will be $ 6.

To obtain information about the FVEAA, you may contact either President Woods or Vice President Shafer:

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August, 1998 PRESSEZ

Fred Kitch will drive his new Ford RANGER to the August meeting. It will be available for inspection from 6:45 until the 7:30 meeting time. It will be rescheduled if it rains.

The meeting will begin with Fred's description of his driving experience and questions.

John Emde will report on his inspection of John Gloff's 1986 Ford Ranger. We also need to take final action on the donation offer of a 1975 FIAT. If you are interested in the FIAT and can't get to the meeting, let me know before meeting time.

Ed Meyer will continue the battery charging discussion with his presentation on charger design.
KEN

MINUTES OF JUNE MEETING

The June meeting of the FVEAA at the College of DuPage was called to order by President Woods. The minutes of this meeting was mangled by the US Postoffice and arrived too late for the next meeting. They were unreadable.

MINUTES OF JULY MEETING

The July FVEAA meeting at the College of DuPage was called to order by Vice President Shafer at 7:45 PM. President Woods was kept at home to help his wife after her recent neck surgery. Secretary Aarvold was also absent and VP Shafer kept the meeting minutes.

Ten members and two guests attended.

Treasurer Corel reported $ 457.80 in the checking account and $ 2322.22 in the checking account. All Participation Share checks except John Stockberger's have been cashed. The report was accepted.

Member John Emde was asked to report on the inspection of the proposed donation by Rich Gloff of his1986 Ford RANGER . John has been unable to arrange an inspection date but will continue his effort. The pickup is a 6-cylinder vehicle with an automatic transmission. The car failed emission tests and has been sitting idle for about 1 1/2 years in Rich's garage. He reports a small amount of rust around the doors.

Subject to Emde's report, the membership established two options for acceptance of the car:

1. If someone in the FVEAA wants to do a conversion. 2: If Rich wants to do a conversion with FVEAA assistance. Estimated cost - $6500.

Former Member Helenowska's offer to donate her 1976 Fiat to a club member was discussed. Her offer is contingent on someone really intending to restore tne car and use it. There is a solar panel on the roof but the car has not been run in about two years. The conversion was made without a clutch. The consensus was that replacement parts for the drivetrain, suspension, braking system and miscellaneous items are not available. It might be useful as a spare parts source for two persons owning Stockberger Fiat conversions : Dave Aarvold and former member Ed Ahern in Warrenville. Final decision on the Fiat will be made at the August meeting.

After the break, Shafer started a discussion of the fundamentals of battery charging. Pass-out information was distributed to persons present. The material covered is included in this Newsletter issue.

He was followed by Ed Meyer who presented material relevant to his most-recent battery chargers for 96-volt dc systems built for Members Krajonvich and Shafer. His presentation was shortened due to time constraints. It will be continued at the August meeting.

The meeting was adjourned at 10:40PM

Submitted by:

Bill Shafer
Secretary Pro-tem

RECENT ARTICLES ABOUT ELECTRIC VEHICLES

Hybrid Electric Vehicles Investigated by UPS, Laidlaw School Bus, and Eby-Brown. Business Week August 3 - Page 4, Navistar "In Brief" June 29, Inside UPS, Aug. 98. Navistar, the builder of those familiar UPS trucks, has developed an experimental HEV that will be tested by UPS in three cities, Johnson City NY, Los Angeles, and Atlanta. Lockheed Martin developed, the prototype HEV package is a partner in this effort. The HEV engine drives a generator feeding a bank of 23 batteries. The system includes regenerative braking that recaptures energy.

The stripped-down vehicle was introduced to one hundred UPS engineers and senior management in Atlanta June 19 and 22. The vehicle has potential to reduce emissions, improve fuel economy, and reduce engine maintenance caused a stop-start cycle at each delivery stop.

Electric car is better deal than you may think. Kane County (IL) Chronicle, Page 3. From Associated Press. Ann Job test-drove the Honda EV Plus. She noted she didn't realize how noisy it is on the roads until her EV experience. She enjoyed bypassing that "smelly, dirty gas station and passing traffic going 70 mph. Honda leases the car for $ 499/month and the lessee must install a home charging station that has an installation cost of $750 made by the local utility.

Thermal Imaging Enhances Vehicle Battery Management. Electronic Design Feb. 98, Page 30. Overtemperature will sharply reduce battery life in an EV, particularly during fast charging. Southwest Research Institute in San Antonio is testing thermal imaging to analyze battery temperatures during charging. The technology can detect temperature differences as small as 5 degrees C.

Dupont reduces price for fuel cell membrane material. Design News 6/22/98, Page S-19. Dupont reduced the price of fuel cell separators made of *Nafion.* The move could reduce cost of this material to as low as $10/square foot and help make fuel cells more competetive.

Will Fuel Cells Power an Automotive Revolution? Design News 6/22/98, Pages 86-96. Many observers now believe the quest for a battery breakthrough for electric cars may be unnecessary as the result of improvements in fuel cell technology. The cost of platinum catalyst needed for a 80 kW fuel cell has been reduced by a factor of 100 since 1984. Fuel cells have three times the energy and power density of batteries now used in electric powered vehicles. A current 50 kW fuel cell could be located in the space now occupied by the floor tunnel in a present mid-sized sedan. Mercedes NECAR-3 drivetrain fits in the rear passenger area of the demo car.

As late as 1994, a DOE handbook on fuel cells lacked a chapter on Proton Exchange Membrane (PEM) technology because of membrane cost. Research by Los Alamos Lab and others changed that. Platinum former loading was 4- milligrams/cm. This has been reduced as little as 0.25 mg/cm by forming a platinum as an ink that is spread and cured on a substrate. The major remaining fuel cell problem is choosing the fuel used.

RECENT ARTICLES ABOUT ELECTRIC VEHICLES - Concluded

Hydrogen is the preferred fuel. In a PEM cell that operates at about 80 degrees C hydrogen introduced on the anode side of a PEM membrane. Two hydrogen molecules give up two electrons that move across the barrier to the anode side where they combine with one oxygen molecule. This makes water that is discharged. This process generates heat that requires fuel cell cooling. There are no other products of this reaction. There is no effective way of storing hydrogen. As a liquid it must be kept at an extremely low temperature in a Dewar flask. As a gas it is either stored in a high-pressure container or in a hydride. Toyota uses a titanium alloy hydride.

If methanol, alcohol, or gasoline is used as a fuel, carbon molecules interfere with or poison the reaction. Getting hydrogen from a hydrocarbon fuel requires an additional procedure called reformation. In this process hydrogen from the fuel. Molecules are "cracked", just as they are in a refinery, except the "refinery" is in the car, on wheels. Miniaturizing the process is both a technical and economic challenge. The A. D. Little system uses gasoline as a hydrogen source. Their reformer is a 17" x 22" cylinder that includes a stainless steel finned heat exchanger. Gasoline is burned in the reformer to heat incoming fuel to 1800 degrees F. This is then sent to a reaction zone where a nickel catalyst converts the methane formed to create more usable hydrogen. The reformer then passes the mixture thru a carbon monoxide cleanup process that reduces CO concentration from 2000 to 10 ppm. Sulfur byproducts are then collected in a trap.

The article has an interesting sidebar on EV electric motors. It describes a Unique Mobility patented motor utilizing **phase advance**. They claim it has the high starting torque of the dc series motor as well the power output at high speeds of a shunt-wound dc motor. Their system uses an electronic switching that generates a 3-phase ac waveform of varying frequency and amplitude. A low-resolution sensor measures the relative position of the rotor and stator to establish six-step commutation. The commutation signal is adjusted to deliver constant power operation. At low speeds, the system operates with pulse width modulation. In the second step phase advancement is introduced until the pulse width is 100%. In the final step, torque is reduced hyperbolically to maintain a constant power output. Systems ranging from 5-130 horsepower have been tested.

(Editor's Note) It appears to me there are emerging three types of vehicles:

1. Battery powered cars useful for most urban driving.
2. Hybrid cars that include small engine-generators in some arrangement that will provide the performance and range customers *seem* to require.
3. Fuel cell cars.

It will be interesting to follow developments.

FROM OTHER EV NEWSLETTERS

AVEA, the Australian EV group in the lead article in their May/June issue discussed Toyota's plans to introduce the PRIUS Hybrid into Australia. No modifications of the right-hand driver system used in Japan. Japan, British and Australian roads are configured similarly. The article provides vehicle descriptions and technical specifications.

Another article describes urban air pollution in Australia. It points out that, like California, urban areas are concentrated on the coastlines. Pollution products are held by hills and low mountains located inland. Current air standards are exceeded on those days conducive to photochemical smog formation. Transport is a major contributor to conditions leading to smog. Recommended alleviation procedures are to reduce vehicle use and clean up engines.

There is an article about wiring the *Camira* conversion that uses 12-volt OPTIMA batteries making up the 144-volt system. Wiring contains features to avoid Murphy's Law. There is a large red knob on the console that must first be closed to provide power to an Albright contactor and to energize the Curtis controller thru a 750-ohm, 50-watt bypass resistor. The keyswitch is then closed to make the car ready to run.

They had an article written by Ben Parker, Editor of the EVAOSC Newsletter, describing the Ford RANGER exhibited at the EVAOSC January meeting. It included technical data, marketing data, expected customers, incentives, product introduction, customer meetings, Ride & Drive evaluations, and media information. (Editor's note - Airway Ford, the dealer selling a Ranger to Fred Kitch, might be interested in this article.).

The issue concluded with a 3-page description of the repair of the ZOMBIE meltdown. Owner John Wayland described the failure in a previous FVEAA Newsletter.

EEVC, the Eastern organization, in their July publication featured Cinnamonson (High Scool) participation in the 1998 Tour de Sol. EEVC members helped the team with final preparations for the event. Club President Oliver Perry saluted EV accomplishments of Japanese automakers. They had an interesting article on ULTRACAPACITORS. Technical data on Maxwell Energy Products PowerCache PC 2623 unit was presented. This is a **ONE THOUSAND FARAD** device that holds 2600 Joules of energy at a nominal 2.3 volts. It measures 60x75x24 mm, weighs 390 grams, and a specific power of 4210 Watts/kg .With a 6-second discharge period, it will deliver 1300 Joules. Additional information on the Maxwell product line can be obtained from the manufacturer, 4949 Greencraig Lane, San Diego, CA 92123 or e-mail power-cache@ maxwell.com

Electric Grand Prix, the Rochester NY group, in their July-Sept Newsletter, noted one of five surviving Ford Ecostar Van has been donated to the Boyertown Museum. They had to promise never to drive it on a public street. The issue also has a description of an EV package that includes a 3-phase, 25 horsepower pancake motor that has a12" diameter and a width of 3.75". It weighs 35 pounds. Motors can be ganged axially. A fact sheet can be obtained from Precision Magnetic Bearing Inc. 36 Green Mountain Drive, Cohoes NY 12047. (518) 783-4343.

FROM OTHER EV NEWSLETTERS - Concluded

SEVA, the folks in Sacramento in their July Newsletter announced plans for a July picnic. Members with an EV were urged to show off their cars - with the caution that no recharging facilities are available at the picnic site. The use of portable gasoline generators was discouraged. They also had a report of EV Education Day at the State Capitol. Seven Assembly members from Northern California were visited.

In their August publication new President Tim Loree noted their July picnic was a success. They also note the US EPA reports 1,904 air-quality violations during the period April 5 to July 20. Los Angeles experienced seven "Stage 1" smog alerts this year so far compared with just one last year. They report a Honda hybrid is due next year and a fuel cell vehicle in 2003.

EV Circuit, the Newsletter of the Ottawa Organization in their May/June Newsletter gave the results of the EVCO Electrathon. Ten schools competed. The winning entry traveled 37.2 km and was radar-clocked at 52 km/hr on one lap. Results of the 3d Annual Queens University electric car contest were reported. Thirty teams entered. Vehicles this year generally substituted belt drives for noisy gear reduction units. Starter motors were replaced with small speciality motors. The two top winners also had transmission systems to negotiate hills on the course..

Fred Green had an article outlining the advantages of driving an EV conversion that retains the flywheel and transmission. Earl Wallingford had an informative article about performance gains by increasing horsepower and torque of vehicles with an AC system.

A reprint from the Montreal Gazette reports that Hydro-Quebec has pulled the plug on their hybrid drive system because of poor prospects for an acceptable return on investment. Three years ago the project was ahead of the competition, but not today.

Miscellaneous

While preparing this Newsletter, I received an unexpected phone call from a person representing Curtis Instruments in the San Francisco area. She had a copy of the April issue of the FVEAA Newsletter and wanted to know if I were interested in talking to Curtis about a job. I replied they really didn't want me; I retired from Commonwealth Edison's Research Staff twelve years ago and am happy with retirement. I told her my electric car hobby "Kept me off the street and out of trouble". She replied, "You mean your car keeps you **on the street** and out of trouble." I referred her to the Electric Auto Association (EAA) in the Bay area that has six chapters with newsletters that are probably read by lot of techies.

BILL

BATTERY CHARGING FUNDAMENTALS

The following material was presented at the FVEAA July meeting. It relates to battery charging. This is a vital ingredient in any electric car. This elementary material may be useful to the non-technical members of the FVEAA and tolerated by the techies. Ed Meyer will present a follow-up discussion of battery charger design and application at the August meeting. His material will be part of the September Newsletter.

A lead-acid battery is a simple device that electrochemically stores electrical energy during charging and delivers energy on discharge. Chemical reactions are reversible. Each cell is made up of a parallel connection of positive plates interlaced with a parallel connection of negative plates. A separator is placed between each positive and negative plate. Sulfuric acid electrolyte fills empty space between each positive and negative plate. The pattern makes each battery cell both a capacitor and resistor. Fig. 1shows the equivalent circuit for a battery cell.

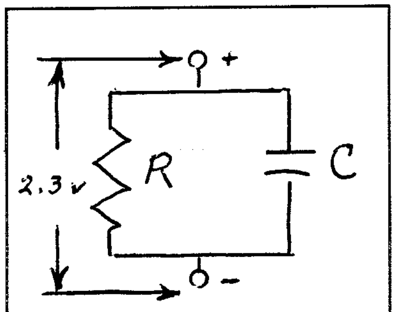


Fig 1. Cell Equivalent Circuit

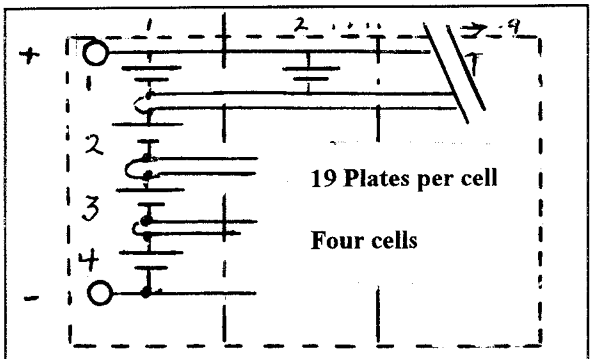


Fig 2 Makeup of a Trojan 8-volt Battery

Each cell produces an electromotive force of 2.35 volts per cell. The Trojan 875 battery has four cells connected in series as shown by Fig 2. The combination produces a 9.4 volt battery open-circuit voltage at full charge.

Utility-provided electricity is AC as shown by Fig 3. The output of a full-wave rectifier shown by Fig 4 is shown as a pulsating waveform in Fig. 5. Note the **peak** value of the AC wave is 170 volts while its **effective** value (Read on an analog voltmeter) is 120 volts. The effective value produces the same heating effect in a resistance as would a DC voltage of similar magnitude.

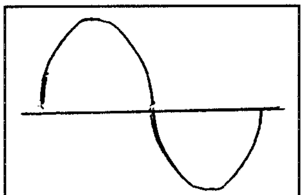


Fig 3 AC Waveform.

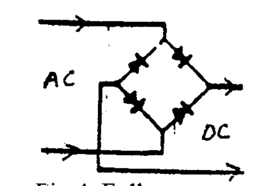


Fig 4 Full-wave Bridge Rectifier

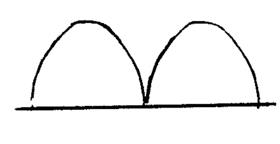


Fig 5 Rectified Output

BATTERY CHARGING FUNDAMENTALS - Concluded

When a battery is connected to the rectified output, only the portion of the applied voltage wave is effective in charging as shown by Fig 6. Note the difference between a discharged battery @ 1.75 volts/cell and a fully-charged cell at 2.35 volts. The useful amount of charging energy is shown by the shaded area of the applied waveform.

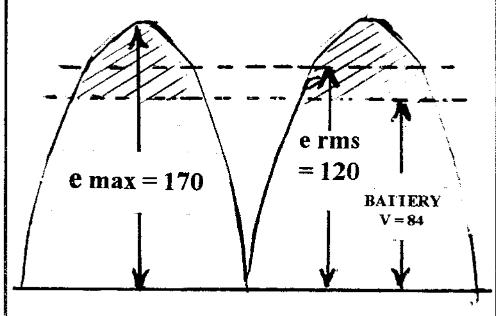


Fig 6 Battery Connected to Output

The peak current during each cycle will be the difference between the peak applied voltage and battery emf. The resistance of 12 Trojan T-875 batteries connected in series for a nominal 96-volt systemis about one ohm. If the rectified output from a 120-volt supply circuit were directly connected to the battery the Peak current (Ip) would be:

Ip = Applied voltage - Battery emf voltage / Resistance

= 170 - (48 cells*1.75 volts per cell)/1 ohm = 170 - 84/1 = 86 amps. (Battery Discharged)

= 170 - (48*2.35)/1 = 170 - 113/1 = 57 amps (Battery Fully Charged)

This is the starting point for battery charging. Effective charging requires addition of control circuitry. The usual charging protocol is to maintain a **constant current** for the first part of the charging cycle, followed by a **constant voltage** for a limited time and finished by a charge maintenance regime. Typically 0.2 amp is sufficient for charge maintenance.

Individual differences between cells connected in series require a periodic **equalizing charge**. This procedure will overcharge some cells while bringing other up to their proper level. Cell differences can be tested using a battery hydrometer. Depending on design. a fully charged cell will register a specific gravity of about 1.280. A partially charged cell will be below this value. During overcharging of a cell the electrochemical reaction will disassociate water molecules into their hydrogen and oxygen components. This explosive combination of gases accumulates in the top part of each cell. A continued need to add distilled water to cells shows excessive overcharging that raises cell component temperatures and shortens cell life.

Some means of controlling the rectified applied voltage is essential for proper battery charging. This will be be the subject of Ed Meyer's presentation of Part 2 of Battery Charging Fundamentals. It will be published in the September isue of the FVEAA Newsletter.

BATTERY CHARGERS

Charging batteries correctly is very important to the life of the battery; the practice of charging has been greatly advanced today with new systems of rapid charging and dependable automatic chargers in use. However, it is helpful to know that over-charging a battery affects the positive plates that eventually may produce positive grid disintegration. Undercharging on the other hand will cause gradual sulfation of the plates and a complete discharge may cause a reversal of polarity making the battery useless.

In order to determine when batteries must be charged a test run is recommended with batteries fully charged, with specific gravity reading 1,260 - 1,280, and readings taken on the run until the voltage cut-off point of 1.75 V per cell is reached. At this point mileage reading can be taken from the odometer and used for reference mileage per charge.

Most chargers are designed to deliver a tapering charge current characteristic to the battery; the conventional eight-hour charger will initiate a charging rate of 20-25 amps per 100 Ah of rated battery capacity tapering to a finish current of about 2-5 amps. More rapid charging is possible but it should be confirmed with the battery manufacturer.

There are several types of chargers on the market, none of them, however, are suitable for use in the electric auto. They are: 12 V charger for automotive batteries and a 36 V charger for golfcar batteries and others for industrial uses. Costwise they are out of range with the 36 V unit starting at $135, and industrial type units in higher voltages starting at $500. Some rapid chargers have appeared on the market recently in a choice of voltages - however, they are still very expensive. However, Universal battery charger for voltages of 36-120 V is available now from Thornton Power Systems, 87 Beaver St., Walthrem, Mass. 02154.

For those who wish to build their own charger we are showing on the back page several simple circuits which will do the job with some attention during charging. However, an electric timer connected between the charger and the AC power supply may be very handy when charging is done at night or otherwise unattended.

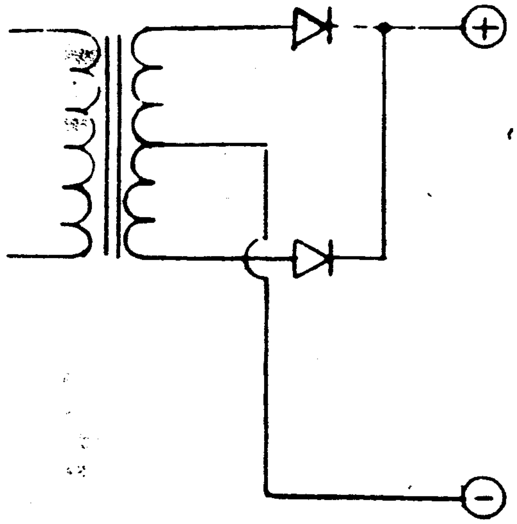
(1) <u>The Unregulated Charger</u>. This type charger does not incorporate voltage regulation and consequently must be disconnected after predetermined time to prevent overcharging. It consists of a center-tapped transformer with secondary voltages about 1/10 higher than the open circuit voltage of the battery and two diodes with 20A max. capacity and voltage twice that of the output voltage of the charger.

(2) <u>The Simplest Regulated Charger</u>. The transformer should provide the required current (20A max.) and voltage (78-80 V for 72V battery). The diode should match the current capacity and should have more than twice the transformer voltage. The variable resistor in series with the diode should be a high-wattage one to carry the 20A current. The Zener diode could a low-voltage one in series with a variable resistor of 10K - 50 K Ohms depending on the output voltage. A Voltmeter should be used across the output terminals to set the charging voltage. Likewise an Ammeter could be used in the positive leg to adjust the current.

(3) <u>Regulated Charger With a Shut-Off</u>. The circuit shown is used for a 72V battery although higher voltages can be used (96V-120V) providing proper voltage transformer and rectifier bridge are used with resistors to match the voltage. A Voltmeter across the Zener diode circuit can be used to set up the voltage or one could be put in series in that circuit for permanent use. The indicator lamp is strictly optional however, it will dim gradually as the battery becomes fully charged providing a quick check on the state of the battery.

OVER →

TYPICAL CHARGER CIRCUITS



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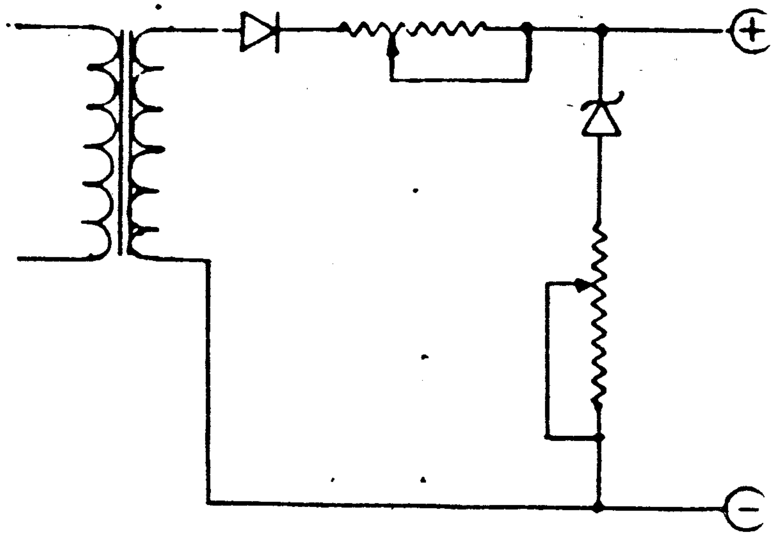

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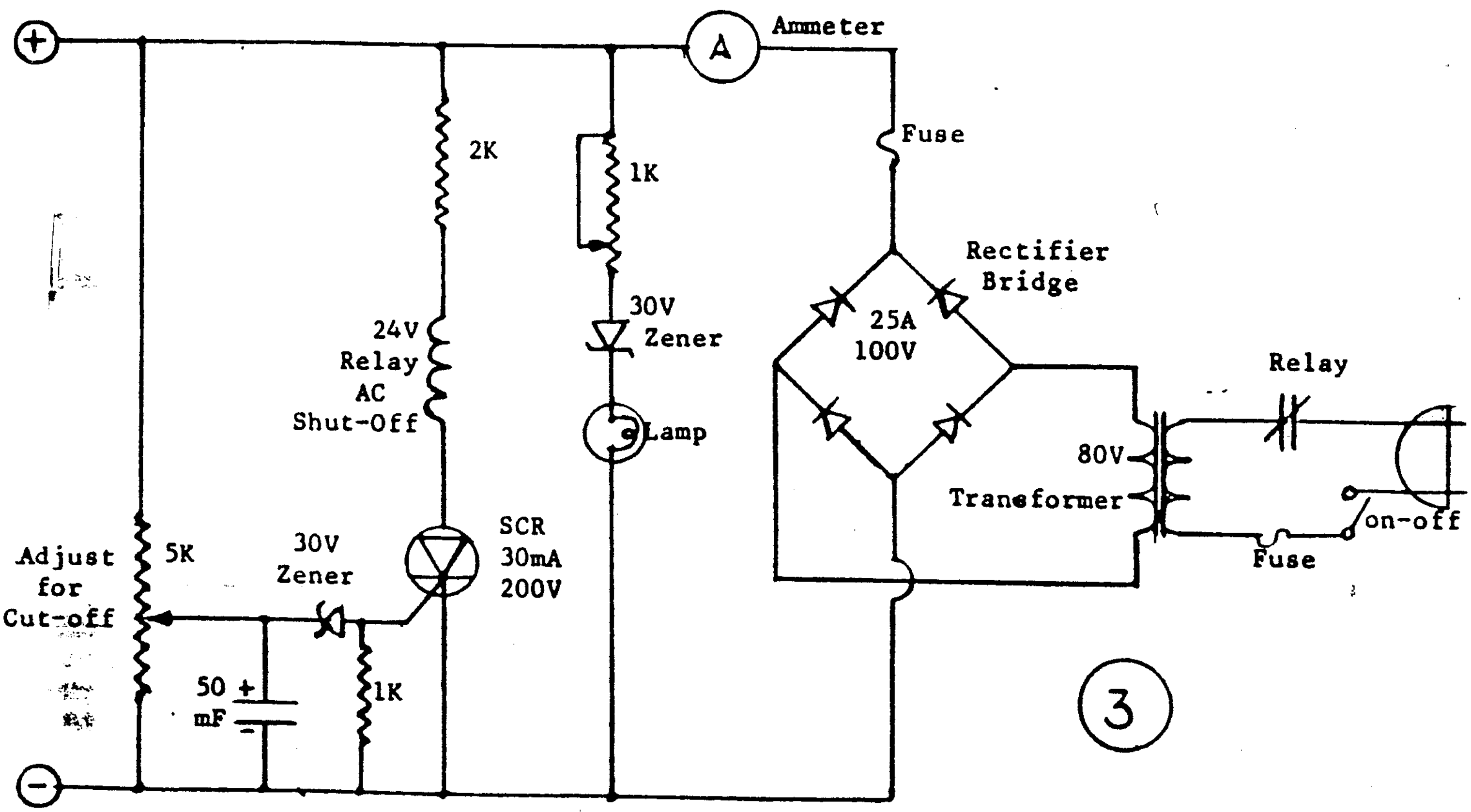

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