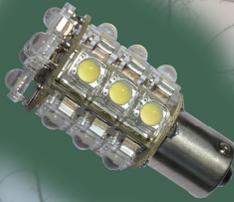


RV Electrical & Appliance Systems

Why They Don't Work and How They Could Be Fixed



Thomas Childs

© 2017 by Thomas Childs.
All rights reserved.
ISBN of printed version: 978-0-692-12657-8

This digital PDF excerpt has no ISBN number. This digital excerpt is for promotional purposes only, and permission is granted to download or copy it, but only in its entirety and unaltered. Permission NOT given to copy/use text or photographs for any other purpose.

All photographs & drawings are originals done by Thomas Childs,
except painting on p. 46, done by my mother, Frances Childs.



(actual fortune of author)

Safety Warning/Disclaimer

This book makes every effort to provide accurate and adequate safety information, and tries to steer people away from dangerous RV devices and practices. Still, all devices have their individual idiosyncrasies. The author is not familiar with individual brand names nor specific models of gadgets, therefore any RV users/customizers should always consult manufacturers regarding safety concerns, and should not hold the author/printer/distributor of this book liable for either injuries or poor performance. (Stated more simply, use this book as a *guide* or starting point for information, but not as a *final authority*.) Here are the more important and relevant RV safety rules:

1) Lead-acid batteries often produce hydrogen gas which can cause batteries or poorly ventilated compartments containing batteries to explode if ignited. Hydrogen may be ignited by open flames of appliances (including pilot lights), lit cigarettes, or sparks made by switches turning appliances on/off, or sparks made within appliances themselves. Lead-acid batteries have sulfuric acid, which can be propelled in any direction during an explosion, and if landing on a nearby person, can cause severe skin burns or even blindness. Always wear eye protection when around batteries. Also, have water handy to quickly wash acid off people in the event of an accident. Get immediate medical help if acid burns do occur. Other non-lead-acid types of batteries have their own safety concerns, which are beyond the scope of this book. Consult manufacturers and other authors.

2) Carbon monoxide is a deadly gas, which can accumulate indoors (especially in small RVs) and kill people. It is made as a byproduct of combustion of propane, gasoline, oil, and other flammable stuff. Read and understand the information and heed the warnings on carbon monoxide, contained in Chapter 4: "Propane."

3) Do not take, spread or use flammable solvents (especially gasoline, which is extremely flammable) indoors, in open or unsealed containers, especially when any propane appliances or candles or cigarettes are burning, or when some appliance or switch might spark and thus ignite these. Ignited solvents can cause fire, explosion or both. This can cause severe injury or death to anyone caught within such.

4) Unburned propane or butane, mixed with air in an enclosed RV space, is poisonous and explosive. Read and heed warning information in Chapter 4: "Propane."

5) Always have a working carbon monoxide and propane gas detector inside your RV. Also have a working smoke detector. To ensure quick escape, be sure the exit door isn't locked from the inside.

6) High voltage electricity can electrocute people. Even 12 Volt low voltage devices may transform the lower voltage to higher voltages.

7) When designing or modifying an appliance, YOU TAKE COMPLETE RESPONSIBILITY for safety. Do your own safety testing.

If I Were Emperor of the World...

Many things annoy me. My annoyance levels range from minor irritation through all out rage. Usually I am powerless to change the things in the world that I do not like, so to cope, I sometimes fantasize that I have absolute power over all other humans, as “Emperor of the World.” I then dream up punishments that I would bestow upon people whom I do not like. I know, I know, it is very unlikely that I will ever be “Emperor of the World.” The logistics of actually achieving such a title approach impossibility, and even if I somehow did manage to claim it, I’d be overthrown or assassinated quite quickly. But let me dream a little! I’ve got to have some fun!

Since I have a lot of interest in RVs, and not much love for the people who design and make them, if I were Emperor of the World, imposing at least some form of torture upon these people would be very high upon my “to do” list. No, I wouldn’t go psycho--- nobody would go to the guillotine and nobody would be drawn and quartered (whatever that is). But I do have something in mind for them that they definitely would not like: *I would make them live in their own RVs for awhile!* I would issue an executive non-reviewable order requiring each RV designer and manufacturer to live in one of their RVs for three continuous months, as actual RVers, in wilderness areas without municipal electricity (can’t plug in--- ever). All persons refusing such an order would be allowed as much time as they needed to rethink their positions and decide to do the task (but they would have to spend all their rethinking time in the dungeon).

Once they began their live-in assignments, the fun would begin. I wouldn’t want to just find out what happens to them from afar; I would park my RV near them, and enjoy observing their follies personally. On cold nights their furnaces would stop heating. I would laugh and they would cry. (My heart would be as cold to their suffering as the temperatures on the insides of their RVs!) Their lights, water faucets and refrigerators would all stop working (they would be forced to throw the food from their fridges away). I would laugh and they would cry. When they parked in the sun on hot days, indoor temperatures would start climbing. They would try to turn on their generators to power up their air conditioners (and everything else), but those generators just wouldn’t start, so they would have no air conditioning. Then, temperatures inside their RVs would skyrocket. They would then be forced to sit outside all day, at which point, I would laugh and they would cry. Then, I might walk on over to them and ask, “Do you think it is possible that there might actually be a technical literal hell? A version of which is right here on Earth? Inside of your RVs?” They would be at the depths of despair.

I would then show them a picture of my mom. “Look at this woman. I watched all this happen to her--- and it was not fun. Now I get to watch this happen to you--- and it *is* fun! You took her money and drove her to tears. You must be very proud of those ‘F’s you got in school. What did my mother ever do bad to you? If this situation was good enough for her, why is it somehow not good enough for you?”

Before leaving, I would say: “Cheer up. RVing is about seeing wonderful things that you’ve never seen before. Today, I will show you something wonderful that you have never seen before.” Instead of showing them some breathtaking natural feature, I would toss them a book about the basics of electricity, and offer to let them keep it.

For the really hideous designers, I'd impose an extra punishment for dessert. On a cold night, I'd invite them into my camper for coffee/tea and a light snack (attendance required). They would stay for a half an hour, all the time of which I would talk incessantly about how well my lights worked, how reliably my furnace worked, and how much I really looked forward to sleeping warm as toast that night. Then, I would kick them out and force them to sleep in their own cold dark campers. Yes, I am evil. It is probably a good thing that I am not Emperor of the World.

What if somebody made an RV with an electrical & appliance system that actually worked? My Emperor's decree would still stand. But if that system worked, living in the RV would be a pleasure, not be a punishment. That would be alright with me. My Emperor decree wouldn't actually punish or reward anybody, it would simply make them punish or reward themselves in direct proportion to their own RV design integrity. It would be beautiful cosmic justice. Maybe I am not so evil after all.

But alas! The fantasy fades. What was I thinking? A world in which RV designers bear the consequences of their own designs? How silly! RV designers decide how RVs are made. RV users have no say. RV designers & manufacturers simply get away with whatever they do. And it will probably stay that way for quite some time. They laugh and we cry. Like I said, usually I am powerless to change the things in the world that I do not like.

I am not Emperor of the World. I am just a dreamer with lots of ideas, who reads books, studies, likes scientific mechanical and electrical concepts and camping. I cannot coerce anyone into doing anything, and maybe that's just as well. I must try persuasion instead. The best I can do is write a book and hope that somebody reads it.

RV Electrical & Appliance Systems

Why they don't work and How they could be fixed

Thomas Childs

Table of Contents

Introduction

Who am I?	14
Why did I write this book?	14
How did my RV days get started?	15
What experience inspired this book?	22
Who is likely to benefit from this book?	23
Who is likely to dislike this book?	24
What does the term “electrical & appliance system” mean?	24
What topics does this book cover that others don't?	25
What does this book <i>not</i> do?	25
How do I differ from many other RV author/users?	26
How did I obtain my knowledge?	29
Tips On Reading This Book	30

Chapter 1

Electricity and RVs

<u>The Role of Electricity in RVs</u>	32
Plug In or Don't Plug In?	32
The Case for Going Off Grid	33
The Case for Grid Dependency	44
Bringing Municipal Electricity Into Campgrounds	47
Should RVs Be Designed to Function Without Municipal Electricity?	51
 <u>Electricity Basics</u>	 53
What is Electricity?	53
Voltage	53
Current and Charge	55
Power and Energy	58
Energy-Charge Relationship	60
Power-Current Relationship	63
Voltage-Current-Resistance Relationship (Ohm's Law)	64
Summaries of Terms & Formulas	66
 <u>Components of RV Electrical Systems</u>	 67
Two RV "House" Electrical Systems	
The 120 Volts AC System	67
The 12 Volts DC System	69
AC Verses DC	70
Power Converters (AC to DC)	72
Power Inverters (DC to AC)	75
Two Operation Modes: "Generator On" and "Generator Off"	75
Batteries	
Battery Basics	75
Problems With Batteries	78
Battery Charging Systems	
The "Charge As You Drive" System	82
The 120 Volt AC Charging System	85
Generators	
What Can They do? Are They the Answer?	86
Generators Make Noise!	88
Physical Factors (88)	
Social Aspects (90)	
Political Aspects (91)	
Easing Tensions (92)	
My Personal Feelings (93)	
Some Disregard the Feelings of Others (93)	
How I Deal With Generator Users (94)	
 <u>Chapter Conclusion: No Easy Answers</u>	 95

Chapter 2
RV Electrical Systems Are Defective!
(Problems & Solutions)

An Analogy: The “Stupercar”	96
<u>The Defects:</u>	
#1: Insufficient Batteries	98
#2: Inadequate Chargers (Efficiency of 3 Amps Charging by Generator) (104)	100
#3: Generators that Start From “Dead” Batteries	108
#4: Energy Hogging Appliances	109
#5: The “Octopus Effect” (20 Things That Can Shut an RV Electrical System Down) (112)	111
The Defects Working Together	113
What Happens When Existing RV Electrical Systems are Used	114
The “Official Plan” For RV Electricity	118
<u>Proposed Solutions to the Electrical Defects:</u>	
#1: Have More Batteries	121
#2: (Standing Systems) Charge With More Current (Moving Systems) Have More Batteries, Cut Electrical Waste	125
#3: Start Generators From Other Energy Sources	135
#4: Use Energy Saving Appliances	136
#5: A Computer to Monitor the System	139
#5: A Computer to Monitor the System	142
<u>Chapter Conclusion:</u> The Biggest Defect of Them All	146

Chapter 3

Making Electricity & Charging Batteries

<u>Harvesting Electricity From Nature</u>	148
Where Does Electricity Come From?	148
How Can Electricity Be Made?	148
From What Could Electricity Be Produced Locally at RVs?	149
 <u>Battery Charging / Electricity Making Strategies</u>	 150
I.) Alternators (Charge As You Drive):	150
Getting Electricity From the “Car” Into the “House” <i>(150)</i>	
Battery Swapping <i>(152)</i>	
Battery Paralleling <i>(153)</i>	
Plugging the “House” Into the “Car” <i>(156)</i>	
How I (the author) Learned to Charge Batteries (while driving)	162
II.) Solar Panels:	
What Are Solar Panels? How do They Work?	169
Advantages of Solar panels	169
Disadvantages of Solar Panels	170
Differences Between Solar Panels and Generators	171
Practical Considerations for RV Solar Panel Use	172
Technical Points	174
III.) Wind Turbines:	
What Are Wind Turbines? How do They Work?	176
Advantages of Wind Turbines	176
Disadvantages of Wind Turbines	177
Practical Considerations for RV Wind Turbine Use	177
Wind Verses Sun	178
Finding Wind	179
IV.) Thermoelectric Generators:	
What Are Thermoelectric Generators? How do They Work?	182
Technical Points	187
Thermoelectric Generators Verses Solar Panels	188
My Own Proposal for an RV Thermoelectric Generator	188
Advantages of Thermoelectric Generators	190
Disadvantages of Thermoelectric Generators	191
V.) Fuel Cells:	
What Are Fuel Cells? How do They Work?	193
How Do Fuel Cells Differ From Batteries?	193
Advantages of Fuel Cells	195
Disadvantages of Fuel Cells	196
VI.) Generators Powering 120 Volts AC Chargers:	
Generators Versus Other Electricity-Production Methods	198
VII.) Charging From Municipal Electricity:	199

<u>Supercapacitors</u>	201
What are Supercapacitors?	201
Differences Between Batteries and Supercapacitors	202
Energy Storage and Voltage Drop	204
Supercapacitor Aided Battery Charging	206
<i>The case for a supercapacitor aided system (206)</i>	
<i>The case against a supercapacitor aided system (208)</i>	
<u>Comparing Battery Charging / Electricity Making Strategies:</u>	209
Advantages/Disadvantages Summary	209
Efficiencies	212
Costs per KiloWatt Hour	213
Ideal Battery Charging	215
Which Electricity-Making Strategies Work Well Together?	216
<u>Chapter Conclusion:</u> The Simplest Might Be the Best	217

Chapter 4 Propane

A Natural Fuel Choice	218
Electricity Versus Propane	218
Properties of Propane	218
Detecting Propane	219
Combustion Byproducts of Propane	221
Carbon monoxide (222)	
Carbon dioxide (225)	
Trailer Propane Tanks	227
A Defect in Many Motorhome Propane Systems	230
Proposed Solutions to the Motorhome Defect (231)	
<u>Chapter Conclusion:</u> Choose Propane for Heating	233

Chapter 5 Appliances

<u>Introduction</u>	235
Do You Speak RV?	
General Criteria for RV Appliances	
 <u>The Appliances</u>	 236
<u>Lights</u>	236
Types of Lights (236)	
<i>I. Incandescent (236), II. Fluorescent (237),</i>	
<i>III. LED (238), IV. Gas Mantle (240)</i>	
Which Light Types are Best Suited For RVs?	243
History of Artificial Lighting	250
Electricity Verses Fire--- Which is Better?	252
Portable Lights	258
Best Overall RV Lighting Plan	259
How Much Electricity Could Be Saved Using Efficient Lighting?	259
 <u>Furnaces</u>	 261
Furnace Characteristics	261
Types of Furnaces	262
<i>I. Passive Convection, II. Central Radiant, III. Forced-Air,</i>	
<i>IV. Hot Water/Steam, V. Catalytic, VI. Direct Discharge,</i>	
<i>VII. Electric Space Heaters, VIII. Heat Pumps</i>	
Which Furnace Types are Best Suited For RVs?	264
Best Overall RV Heating Plan	273
How Much Electricity Could be Saved Using Efficient Heating?	274
Furnace Stories:	
“My Stove is Also My Furnace” (275)	
“Some Like it Cold” (275)	
“I Just Can’t Figure Out...” (277)	
“My Old Reliable Furnace” (277)	
The 99 Night Field Test	279
Progress--- But In What Direction?	283
Final Thought on Furnaces	284
 <u>Stoves & Ovens</u>	 285
Types of Stoves/Ovens	285
<i>Indoor Gas Stoves, Outdoor Fold-Down Stoves,</i>	
<i>Outdoor Portable Stoves, Conventional Ovens,</i>	
<i>Microwave Ovens, Charcoal Grills</i>	
If you don’t have an oven...	290
Alternatives to Cooking with Electricity	292

<u>Refrigerators</u>	294
Types of Refrigerators/Coolers	294
<i>I. Ice Boxes & Coolers, II. Compression,</i>	
<i>III. Ammonia Absorption, IV. Thermoelectric</i>	
Which Refrigerator Types are Best Suited for RVs?	295
Best Overall Refrigeration Plan	303
<u>Air Conditioners</u>	304
Active Air Conditioning (uses power sources)	304
Types of Air Conditioners	305
<i>I. Compression, II. Evaporative,</i>	
<i>III. Ammonia Absorption, IV. Solar Powered Fans</i>	
Which Air Conditioner Types are Best Suited for RVs?	306
Passive Air Conditioning (no power sources)	313
Passive Air Conditioning Variables	313
<i>I. Reflection (313), II. Insulation (317),</i>	
<i>III. Ventilation (322), IV. The Greenhouse Effect (323),</i>	
<i>V. Heat Storage Within Objects (327),</i>	
<i>VI. The Chimney Effect (328)</i>	
Best Overall Comfort-Cooling Plan	330
<u>Water Systems</u>	331
Water Pumps	
Types of Water Pumps	336
<i>I. Demand Pumps, II. Compressed Air, III. Hybrids,</i>	
<i>IV. Gravity, V. Manual Pumps, VI. Municipal Water</i>	
Which Water Pump Types are Best Suited For RVs?	337
Hot Water Heaters	
Types of Hot Water Heaters	354
<i>I. Pilot Light, II. DSI., III. Electric, IV. Tankless,</i>	
<i>V. MotorAid, VI. Combined With Furnaces</i>	
Which Hot Water Heater Types are Best Suited For RVs?	355
Toilets	
Types of Toilets	360
<i>I. Folding Toilets, Bags & Jugs, II. DryFlush,</i>	
<i>III. Composting, IV. RV Water Toilets,</i>	
<i>V. Small Portable Chemical Toilets</i>	
Which Toilet Types are Best Suited For RVs?	361
Washing Machines & Dryers	369
<u>TVs, Stereos & Other Electronics</u>	371
120 Volts AC Appliances in RVs (371),	
TVs (372), Stereos (374), Computers (374), Printers (375),	
Small electronics with rechargeable batteries (375),	
Electronics then and now... (376)	

<u>Things that Support Appliances</u>	377
Switches	
Master Disconnects	377
Timer Switches	377
Connectors	
Trailer Connectors	378
Aluminum is a poor metal choice for electrical connectors	378
Appliance & wire connections	381
<u>Testing Appliance Currents</u>	382
<u>Chapter Conclusion: Choices Exist But One Must Look</u>	386

Conclusion

<u>Building Better RVs</u>	
A New Plan	387
Dealing With Existing Building Codes	388
What Would a Thomas Childs RV Be Like?	389
The Appliances (389)	
The Batteries (392)	
The Charging System (392)	
Other (Non-Electrical) Requirements (394)	
Testing RVs	395
The Three Month Field Test (396)	
Responding to Customer Feedback / Warranties	398
<u>The RV World is Loaded With Problems</u>	
Why Are RVs Built to Lower Standards than Other Things?	399
Why are RV Electrical & Appliance Systems Particularly Bad?	399
Other Problems	400
Is There Hope?	400
<u>What Can We All Do?</u>	
What Can New RV Buyers Do?	401
What Can Existing RV Owners Do?	401
What Can RV Manufacturers Do?	401
Let's Not Allow Off-Grid Camping To Die	402
Let's Communicate	402
<u>Some Final Philosophical Thoughts</u>	
The RV as a Metaphor For Waste in America	403
The Future of RVing (Can RVs Go "Green?")	404
What Have I Learned From My RVing Days?	405
Camping as a Metaphor For Life	406
Index	407

Introduction

Who am I?

Hello. My name is Thomas Childs. I have many interests in life. These include photography, playing the piano, teaching, clean renewable energy and having dogs. Of most notable interest for readers of this book, I am an avid RV user and lover of wilderness. I also love to write, which is a good characteristic for anyone to have, who has information that might be of interest to others.

There is nothing quite like the RV lifestyle. Nothing matches the feeling you get from waking up in your own bed, 1000+ miles away from your regular “home,” packing up, driving several hundred miles to still another part of the country you’ve never seen, then still sleeping in your own bed that night (and every night). Of course, the leftovers from that great pot of soup you’ve recently made are still in your refrigerator, waiting to satisfy you the next time you get hungry. The can opener, the scissors, the peeler, the dishes, and all your other worldly camping possessions are still in the same spots of your drawers and cupboards, even though you may have relocated hundreds of miles away since putting them there.

I’ve had and seen a lot of really great things right in my own camping “yards”: saguaro cactuses, redwood trees, sequoia trees, a petrified forest (which looked like jewelry), lava-rock beds, herds of elk and bison, snow covered mountains (which were indigo just before sunrise, then suddenly turned pink when sunlight first hit them), stunning dessert rock formations, babbling brooks, riverfronts, lakefronts (some with half a dozen distinct color bands in the morning, others with pure blues and greens), alligators and cypress trees in the Everglades swamp, geothermal features with color combinations I didn’t even know existed. I love experiencing this country in an RV.

But there is something about RVing that I don’t like. For many people, the RV experience gets ruined by poorly designed and mismatched RV equipment. It also often gets inadvertently ruined by the RV users themselves, who though not stupid, are often unaware as to what equipment they should have and how they should use it.

Why did I write this book?

I wrote this book because over the years, I have gotten really good at living in an RV on primitive public lands without electricity, and feel I should share this knowledge with others who may be interested in doing the same. Whether or not I am world class at RV living off the grid is not for me to judge, but I will say this: While out and about, I meet many other RV users who struggle to stay comfortable, but I no longer meet people who have their system of gadgets and procedures working as well as mine.

How did My RV Days Get Started?

In 1985, while in my early twenties, I was recovering from a psychiatric episode and a bad college experience. (I was without worthy goals.) I had been down in the dumps for months. My mind started cleaning house. It was time to run away and not look back. I quit going to college, quit trying to get a college degree, quit my psychiatrist and quit taking all anti-depressant drugs. Then I won a case for some disability benefits from the government. It wasn't much money, but it was enough to get by.

One night shortly thereafter, at about 4:00 in the morning, I had a wild idea as to how I should spend this new found "wealth" to jump start my life: buy an old dilapidated camping trailer, and a car to tow it, fix the trailer up, and use the trailer as my home while traveling, visiting & photographing the beautiful National Parks and Monuments of the United States. Try as I might, I couldn't think of any reason not to do this (other than maybe I should live my life solely to please other people--- but that's just rubbish). So I went for it. Hard work, patience and a lot of swearing turned this dream into a reality. After six months, the initial repairs were done making it ready for use, and after about five years of cycles of trailer tearing apart, rebuilding, then camping, I had rebuilt the trailer to a like-new state. After that, I just maintained it, fixing things as they broke.

To date, I have visited over 40 national treasures while camping in 32 different states for a combined total camping time length of over three years (if all trips occurred end to end).

I still have the trailer and I still use it today in 2017.

I have been free and sober from anti-depressant drugs since 1984. I don't miss them.

Warning: If you want to get off of antidepressant drugs, you should seek medical help. There are some doctors who are willing to help you do this. Trying to do it yourself or quitting "cold turkey" can result in suicidal behavior. Generally, the way to get off is to gradually lower the dosage to zero over a period of several (maybe six) months.

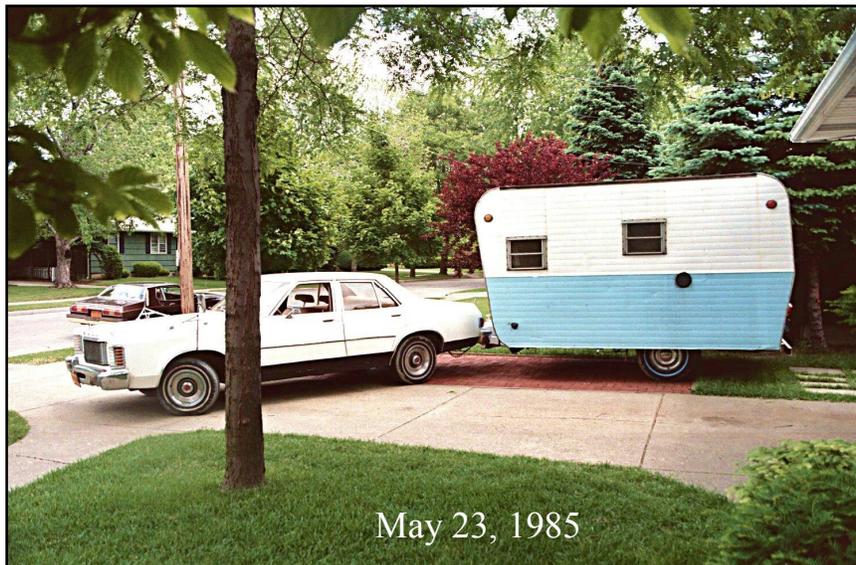
I never did get a college degree, though I did go back to college "buffet style."

I took a number of science/technology classes.
College can be a great experience but only if one goes for the right reasons.

1985

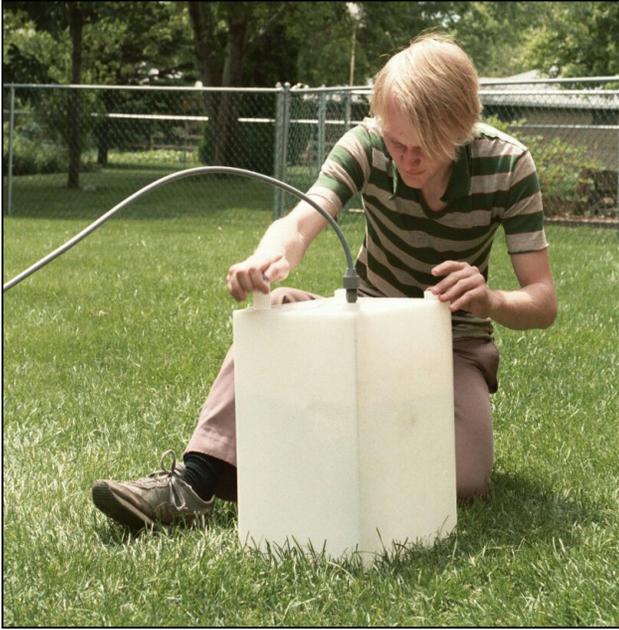


above: junky trailer sitting in the driveway of the lady who sold it to me
below: brought it home



What was I thinking? I accepted that trailer about as much as an organ recipient accepts a mismatched kidney. But it was mine. I did this. Oh well...

Time to get to work...

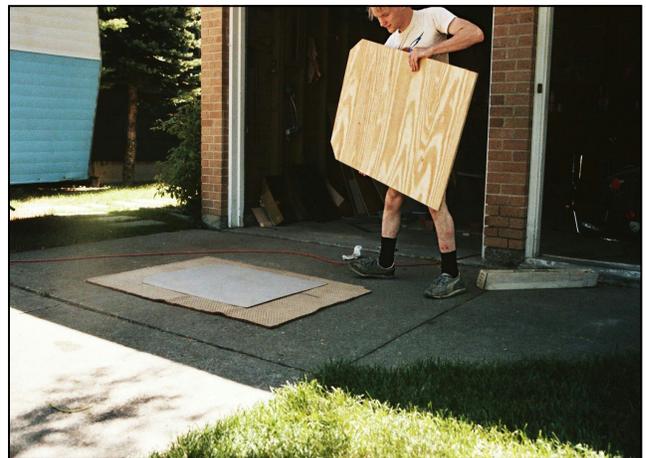


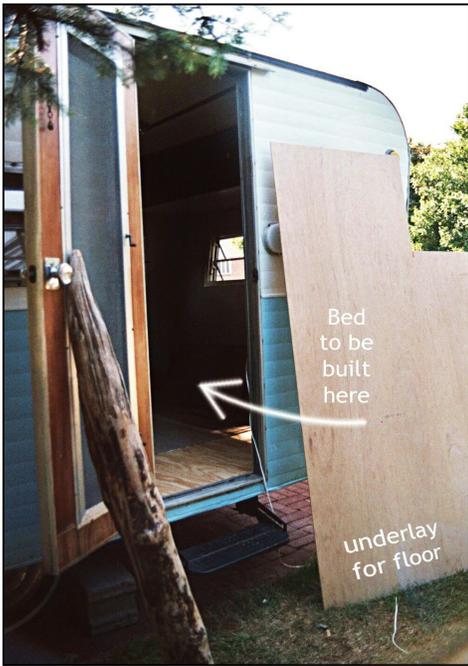
above: experimenting with the plumbing system
below: making & painting cupboard doors





above: cutting holes in new countertop (for stove & sink)
below: making & gluing together kitchen table





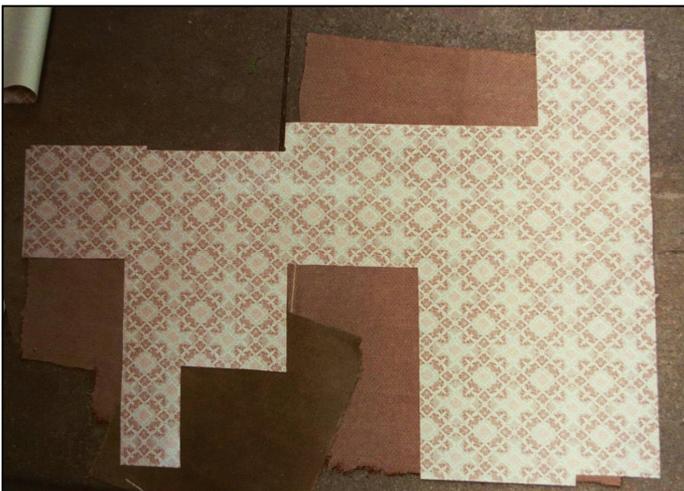
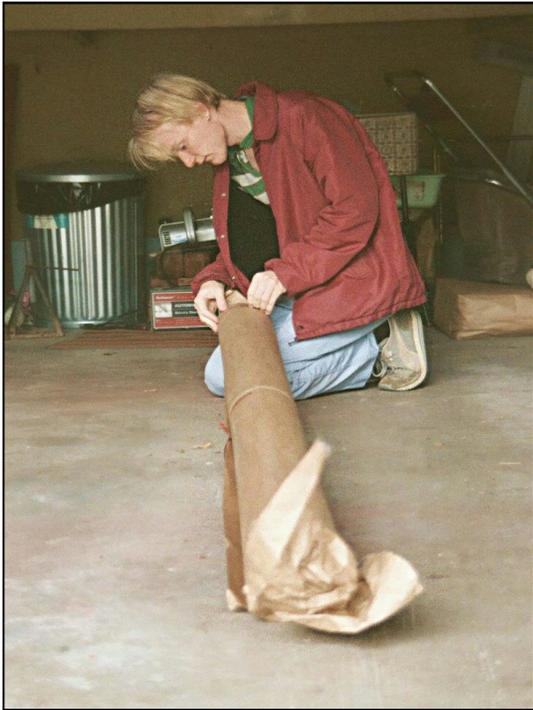
“You made your bed, now sleep in it.”

Well, I *made* my bed. And I *do* sleep in it.
It is really quite comfortable.



Folks, this was 1985. I don't look like a middle school student anymore.

this page: the floor



It took quite a bit of nerve to cut this floor, since I only had one chance to do it right. The taped together construction paper pattern I made in the trailer was my cutting guide. This cut (*left*) turned out to be a perfect fit. This floor is still in my trailer in 2017 and still looks quite good.

1989

below: putting on new siding



What experience inspired this book?

Twenty years later, in 2005, my mother joined the RV camping equation. After having been widowed for three years, Mom told me that she was interested in visiting some National Parks while touring this country in a motorhome. “Great!” I said. “I’ll help you pick one out. We’ll caravan together. You camp in yours and I’ll camp in mine. Motorhomes are designed to function well and keep people comfortable in wilderness.” Talk about words that have come back to haunt me! Boy, I could not have been more wrong. That last statement will probably go down as one of the top five stupidest remarks I’ve made in my entire life.

That summer, after buying a used motorhome, we drove it from her home in Florida to my home in New York, then went as far west as Colorado before parking in a National Forest. There, it happened. Everything in her motorhome started to shut down just a few days after being parked. She shivered in the cold at night, as her furnace shut down. She baked in the day, when the sun hit her poorly insulated roof, turning her RV into a “hot box” (her words). Her refrigerator stopped working. Water stopped coming out of her faucets. Her lights stopped working. Her generator wouldn’t start. Her battery charger wouldn’t charge. We even had trouble filling her propane tank. I tried as best I could to get her system working. I figured, if anybody was capable of getting that system working, I should have been, because after all, I’d been an RV user for twenty years, and had long since solved the equipment problems unique to RV living. (My trailer parked in the campsite next to her functioned just fine during this ordeal.) But no matter how I tried, I could not get her system working, except for very brief time periods. Early one morning, after spending the night shivering in the cold, Mom knocked on my trailer door: “I want to go home!” So I put my van and trailer into storage in Colorado, then helped her drive her motorhome back to her house in Florida. After we got there, I took a plane back to Colorado, reunited with my van and trailer, then finished my trip alone, camping for a little over two months. Returning to Florida marked the end of Mom’s “living-in-an-RV” days. Although we did get some use out of her motorhome for weekend camping in Florida, the only camping she got out of it that was long-term & far-away was: *one day* visiting *one National Park*.

Although I had been aware of some of the RV design problems prior to this trip, from conversations with other RV users, I had been largely in the dark as to how bad typical RV electrical & appliance systems really are. After this trip, I developed a keen interest in them and began studying them. I read technical RV gadgetry data in websites. I read other books on RV life-off-the-grid. I read books on electricity in general. As I began to understand these RV systems, three things became clear: First, although Mom’s motorhome was twenty years old, these failures were not due to the age or wear-and-tear of the gadgetry, these were actually design failures (problems with the plan itself). Second, Mom’s problems were just the tip of the iceberg. Nearly all RVs have the same design problems as her RV did. And third, as I began crunching some numbers, comparing overall electricity consumption rates with battery storage capacities and charger charging rates, I came to a conclusion: It is an understatement to say that RV electrical & appliance systems *don’t* work; it is more correct to say that these systems *can’t* work.



above (2017 photos): Mom's RV decaying in yard several years after her ill-fated trip. RVs are not the only things that decay, so too do people's dreams.

So in 2008, I began writing this book to blow the whistle on some really lousy engineering and take some revenge against some really lousy engineers. But I also wrote this book to help people to redesign and modify their RVs to get those RVs working right. (People must be willing to invest some time, money and effort in order to do this.) I've been writing the book for over nine years now (2017). I don't know why I can't seem to complete anything within a reasonable time frame. I don't know if I will ever finish this book.

Who is likely to benefit from this book?

Anyone who actively uses or is just considering using an RV in places without municipal electricity is likely to benefit from this book. RV owners and customizers, willing to make modifications, will probably love this book, especially if they are willing to experiment and use less-well-known equipment. Though not intended for this purpose, I think that people with permanent remote stationary houses or vacation cottages or tiny houses, not connected to municipal electricity, will also benefit from this book, because many of the same principles that apply to off-grid RVs also apply to off-grid houses and cottages (and tiny houses on wheels are technically RVs anyway). Although this book harshly criticizes current RV designs, some RV designers, who are genuinely interested in improving off-grid performance of their RVs, may actually like this book. Perhaps Park Rangers and Forest Rangers, who have a lot of contact with campers, will also find this book helpful for giving technical advice to campers or just understanding camper stories.

Who is likely to dislike this book?

RV designers and manufacturers, who want to continue making and selling stuff with the same old dysfunctional designs, while hoping that nobody notices, will hate this book. RV designers and manufacturers, who think that they are “too good” to take any advice from RV users, will hate this book. RV designer and manufacturers, who want to cut corners to boost profits, will hate this book. Some private RV Park owners may dislike this book, as they may feel that camping in wilderness instead of at their RV parks may encroach upon their profits. Persons who just want to learn how to use their existing RV systems without making modifications, will not find this book helpful. Finally, RV users, who always stay in places with municipal electricity, are unlikely to find this book helpful.

What does the term “electrical & appliance system” mean?

Many authors use the term “electrical system” to mean the sum total of all related components having anything to do with electricity. Any complete “electrical system” can be divided into three branches: *making* electricity, *storing* electricity and *using* electricity. The appliances that use electricity are often overlooked by other authors (but not me), so instead of using the term “electrical system,” I use “electrical & appliance system,” to indicate that I also consider the (branch of) appliances that use electricity. My definition goes further. Some appliances can be designed to use no electricity at all. Any non-electric appliance, used instead of one which normally consumes electricity, is also a part of an “electrical & appliance system,” because non-electric alternatives directly effect such a system by lightening its electrical load. (By this definition, I consider the entire propane system to be part of the “electrical & appliance system.) Finally, anything that effects the efficiency of appliances (such as insulation in walls, which effect both furnaces and air conditioners), is also a part of an electrical & appliance system, because these too effect electrical loads.

What topics does this book cover that others don't?

Making electricity (for battery charging)

1) One of the best methods of making electricity is to charge batteries while driving a detached car/truck. This is the cheapest, easiest (both to install and use), and possibly the oldest of all the methods, and it makes lots of electricity. Yet, other prominent books on RV electricity don't even mention it. This book covers it in detail.

2) One of the best methods of charging batteries for RVs parked in wilderness may be with thermoelectric generators. Yet I've seen no other books on RV electricity that propose their use nor even mention them--- I don't think these authors even know what they are. What are thermoelectric generators? Why might they work well in RVs? Find out in Chapter 3.

All three branches of RV electricity (making, storing and using it)

Many books on RV and 12 Volt electricity systems focus on only two of the branches of electricity (making and storing it). They go into enormous detail about electricity making and batteries, only to allow the system to be neutered with the most energy-wasting appliances imaginable. This book covers electricity-using in detail (emphasizing energy-conserving appliances). Other authors focus entirely on one branch, the batteries, going into elaborate detail on how to charge them, while erroneously assuming that RV users are going to find electrical outlets all over the place to plug the battery chargers into. (This approach leads to finely detailed information that is completely useless in the wilderness.) This book considers not only battery chargers, but where the electricity (or energy) needed to run those chargers is supposed to come from.

The good and the bad

Some authors are just too optimistic about certain equipment (such as solar panels, which don't work in the shade). I like to see both the good and the bad. While some gadgets work almost universally and others fail universally, most fall somewhere between those extremes. Most gadgets work well under certain conditions but fail under others. I like to note the differing conditions under which a given piece of equipment is likely to either work or fail.

What does this book *not* do?

This book does not consider specific models nor specific manufacturers of RVs and RV components nor quality of equipment that's out there. Information is only given for general design types, including which designs are or aren't likely to work, and under which conditions those designs are or aren't likely to work. I would need a sizable staff and budget to independently test and report on specific brands & models of RVs and their components. I have neither of these.

How do I differ from many other RV author/users?

Many authors are far too friendly toward the RV industry and their designs. I'm not friendly toward that industry. I'm not afraid to call a "cow plop" a "cow plop."

Many other RV author/users plug into municipal electricity once in awhile. I camp exclusively off-grid.

Much RV literature is written by people who use RVs *as they are*. (They teach others how to do the same.) I write about RVs as they *could be* or *should be*.

Many people buy new RVs, which gradually get old. I bought an RV old, which gradually got new.

Many people keep their RVs only a few years before trading them in. I've kept mine for over three decades.

Many RV users spend big bucks on their RVs. I built mine on a shoestring budget.

Elaborating a bit...

Calling a "cow plop" a "cow plop"

Some other authors may be receiving heavy financial backing from the RV industry. Others may be getting funding from private RV parks. This can influence author judgments. Readers may think they are getting objective reviews, when in fact, they are getting cleverly disguised commercials. Other authors may just want to be a bit too nice and positive. I am free of all of these vices. I give an independent point of view.

Camping exclusively off-grid

You may be wondering: "Does this guy cheat a little bit? Does he really *never* plug into electricity when he camps?" Well, everybody cheats a little, I suppose--- even Amish people cheat a little on their religious/lifestyle choice of foregoing electricity, by sometimes using flashlights and radios. Consider this: 1) Multiple times, I have gone three continuous months without plugging my trailer into electricity even once. [Twice, I went over four continuous months without plugging in.] 2) I almost always stay at places without electricity. When I do stay at a park that has both electric and non-electric sites [not that often], I almost always choose a non-electric site. I choose an electric site only when that's the only type of site available. 3) Once, while working as a photography director at a children's summer camp, I brought my trailer to serve as my residence. [I was the only "kid" at camp who brought his own house.] Although electricity was within reach, for the entire two and a half months that I worked there, I never bothered plugging in. 4) The only substantial "cheating" I do is at Laundromats. While my cloths are washing & drying, I often can be found sitting at a table with my laptop plugged into the wall, writing a book about RV electricity.

I believe that the only way to truly break free of the municipal electricity habit, is to never have it. If I plugged into municipal electricity even sometimes, I might begin to like it and become dependent upon it (or at least more comfortable with it). By never having it, I've forced myself to learn how to make and use my electricity, and to use it sparingly, and find other ways of accomplishing tasks normally done with electricity. I can therefore be equally comfortable anywhere.

RVs as they *could be* or *should be*

When evaluating designs, I care not one iota about what “everybody else does” nor if “that’s the way it’s been done a long time.” I just want to know *if it works*. Look, if tomorrow all RV manufacturers decided to do away with round wheels and replace them with square wheels, some people might actually “go with the flow” and write books on how to get the most of those square-wheeled RVs, and how to keep the corners of those wheels nice and sharp, but I wouldn’t. I would tell people to lose those square wheels and replace them with round ones ASAP. I have no desire to learn how to use, recommend, nor teach others how to use dysfunctional equipment. If you just want to learn how to use your existing RV equipment *as it is*, throw this book away and find one written by some author other.

Buying old and becoming new

Starting with an old trailer and having it gradually become new had advantages. I needed only a minimal investment for the initial trailer purchase (\$750--- believe it or not). I gradually added money to it for raw repair materials, *as needed, when I felt like doing the work and when I had money to buy stuff*. My trailer then *improved* with the passage of time. This is in sharp contrast to the experiences of most, who put a lot of money up front for their initial RV purchases. They often must borrow that money, which locks them into payments. Then, their RVs *deteriorate* with the passage of time. They often encounter further financial burdens, when their RVs need repairs far more frequently and that are far more costly than anticipated, possibly putting their RVs outside their workable budgets. Then they try to sell their RVs, only to discover that RVs depreciate extremely rapidly. I’ve had to deal with none of these problems.

Keeping an RV for three decades

Suppose two middle-aged guys wrote books on marriage. The first was married five different times, each for a few years. The second was married only once but for thirty years. The five-wife guy would know a lot more about “what’s out there in the playing field” or “reeling them in,” but would lack knowledge as to how to “make it last.” The one-wife guy would lack knowledge as to “what’s out there in the playing field” or “reeling them in” (because he only needed to do this once), but would know a lot more about how to “make it last.” Whose perspective would be better? I dare not say. I think they both would be experts, just in different areas. I’ve had a single RV for 30+ years. I know how to keep an RV alive a long time. I’ve also had a lot of time to can-tinker and experiment, to get the right stuff in the right places and get everything in my RV working as it should. I don’t think this would have been possible, had I owned multiple RVs, each for a few years. Just want you to know where I stand.

A shoestring budget

I bought my initial trailer “as is” for \$750 in 1985. Over the next few months, I put about another \$750 into it in the form of repair materials. I did the labor myself, at a cost of \$0, so I saved big. The initial car to tow it was \$1100 plus about \$600 in professionally done repairs. Over a six year period, the total cost of the trailer repair & customizing materials was just below \$6000 (including the trailer itself), which was about the price of a new trailer at that time. Over the years, I have kept the trailer up. It probably averages just a few hundred dollars per year in maintenance. (In 2014, I installed a new refrigerator, costing about \$1000 for everything. This was atypical. Most years, the maintenance is probably less than \$200.) The biggest overall expense is for replacing and maintaining the tow vehicles, the last of which I paid \$6100 for in 2005. I estimate that adjusted for inflation to 2017 prices, an equivalent trailer could be built for about \$12,000. If a used tow vehicle were added, the entire package could be obtained for under \$20,000.

I believe that RVing and National Parks visitation should be for everyone who wants the experience, not just for rich people. I am living proof that a person of modest means can successfully RV. For the first fifteen years that I did this, my only income was SSI. (Since then, I’ve gotten Social Security Disability, which is somewhat more.) I’ve been on Medicaid, even sometimes on food stamps, yet still was able to do this. But if you’re richer than I, keep reading. All the tricks that I’ve learned over the years could work just as well in expensive RVs as they have in my simple one. (In fact, many of my suggestions are geared toward higher cost RVs.) It bothers me when someone with an RV, costing six times what mine did, parks next to me, and their equipment doesn’t hold up nearly as well nor as long as mine does. I would like it if luxury RVs could someday function as well as my shoestring budget RV does.

How did I obtain my knowledge?

I do not attribute my RV knowledge or success to superhuman intelligence (which I don't believe I possess). Instead, I mastered the art of RV living off the grid primarily by doing a lot of it. There is a saying: "practice makes perfect." Of course, this is untrue; there is no such thing as perfection. However, practice does make people very good at things. If you play the piano a lot, you just might get good at it. If you ice skate a lot, you might get good at it. If you drive a car a lot, you might get good at it. RV living off the grid is a skill, like all of these--- if you do a lot of it, you just might get good at it. It also helps to be observant, willing to experiment, willing to listen to others, do some internet research and have good intuition.

Elaborating a bit...

Willing to experiment: Besides physically reconstructing much of my RV, I have personally selected and installed all my appliances. I have modified many of them to make them work better.

Listening to others: Much of my knowledge comes from conversations with other RVers. They have such good insights, that it would be a shame if nobody wrote their thoughts down, and shared them as public knowledge with other RVers everywhere.

Internet research: I get a lot of really good information from tuning onto internet blogs posted by other RV users. I also like to sift through RV dealers' parts catalogues, to see what's available, and to get and analyze technical specifications (like consumption rates) that often go missed by others until they actually buy something, put it in their RV, then find out that it doesn't perform the way they'd hoped.

Intuition: I know the realities of RV off-the-grid living well enough such that I can make good educated guesses as to what designs will or won't work and the conditions under which they will or won't work. (Gadgets are effected primarily by weather, but other variables also effect performance.)

One more attribute that gives me good RV knowledge: When most children grow up and first move out on their own away from mommy and daddy, they usually go live in an apartment or a college dorm (or maybe military housing). Not me. The first time I ventured away from my parents, I lived in my RV trailer. RV living therefore became very natural for me. Sometimes I feel more "at home" in my trailer than I do in my regular traditional house.

End of Free Reading

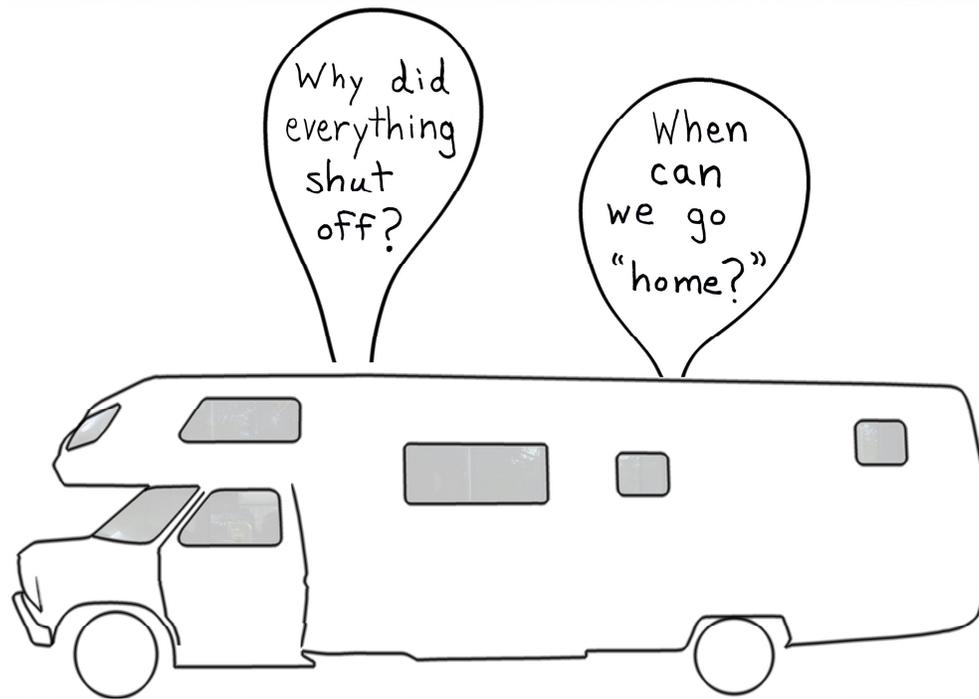
Alright, the first 29 pages is the portion of the book you got for free. If you want the rest, you need to buy a printed copy. The book is currently not available in e-formats. I don't know if I will make it available in any e-formats, but if I do, it must have page numbers, text boxes and color photography.

The Table of Contents should give you a real good idea as to the content and outline of this book.

To order, go to my website
or contact me at campionocal@gmail.com.

Thomas Childs

Many people shell out big bucks for RVs, expecting well engineered electrical & appliance systems that work anywhere— not just in expensive RV parks with electricity.



Instead, they get furnaces that **don't heat**, battery chargers that **don't charge**, generators that **can't start** when needed most, and **not enough batteries** to run their things for long enough time periods to be practical.

RV designers would like you to believe that their creations are technological “masterpieces,” but often RVs are junkpiles of poor engineering. This book, written by an actual RV user (not a promoter), who camps exclusively off grid, gives you the REAL scoop.

The book does more than just complain though, it offers SOLUTIONS:

- * It tells you which appliances work in RVs and which don't.
- * It covers electricity conservation.
- * It covers making electricity and charging batteries in wilderness (a topic that stumps many).
- * It proposes a new set of standards for building and testing RVs.