HOBBY CORNER

Here's our new look

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

THIS IS THE FIRST "HOBBY CORNER" IN the new format that we have been promising. Don't expect the changeover to be immediate—neither Rome nor magazine columns are built in a day. Gradually, though, we'll ease into full stride.

As we begin, you should be aware of the "rules of the game." First, of course, is what we have stated before—that this column cannot provide new circuit designs for esoteric applications. There simply isn't enough time in the month. Second, keep in mind that there is only one Jack Darr—and I am not him. Unlike Jack, I am unable to troubleshoot your equipment by remote control, even on those occasions when you provide what appears to be sufficient information. At best, I may be able to offer a suggestion for an approach to solving your problem, as is the case with George Santana (see below).

Next, as many questions as possible will be answered here in the column. Those questions will be the ones which have the widest interest. Please do not expect an individual reply in the mail. Once again, there just isn't enough time.

From time to time, I will provide a reference to an article or book. You will have to dig up the material. Copyright laws prevent our selling or even giving away copies of a few pages of this or that. Possible sources are the original publishers, your local library, and friends who squirrel away magazines year after year.

I want to thank those of you who have already sent inquiries, and those who will send them. Keep them coming and remember that it may be several months before your question appears.

AN INVITATION

To better meet your needs, "Hobby Corner" will undergo a change in direction. It will be changed to a question-and-answer form in the near future. You are invited to send us questions about general electronics and its applications. We'll do what we can to come up with an answer or, at least, suggest where you might find one.

If you need a basic circuit for some purpose, or want to know how or why one works, let us know. We'll print those of greatest interest here in "Hobby Corner." Please keep in mind that we cannot become a circuit-design service for esoteric applications; circuits must be as general and as simple as possible. Please address your correspondence to:

Hobby Corner
Radio-Electronics
200 Park Ave. South
New York, NY 10003

High-voltage generator

Twelve-year-old Eric Jackson (Ontario, Canada) sent the diagram of a battery-operated high-voltage generator and asks how to make a smaller one. Well, Eric, let's talk a bit about how and why the device works. Then you can try various components until you get what you need.

The circuit in Fig. 1 shows a basic circuit of the type you have. A transformer, as you know, is a device that increases or decreases voltage, as determined by the ratio of the number of turns of wire on each side. The one shown is connected as a *step-up* transformer—there are more turns on the output side than on the input side, and the output voltage is higher than the input voltage.

A transformer will not work on DC—it depends on the electromagnetic field

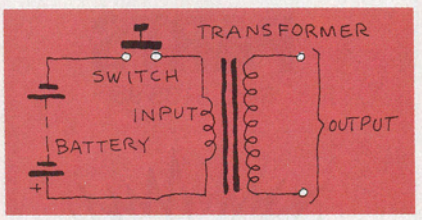

FIG. 1

changing; that's just what happens when AC is applied. The object, then, is to convert the DC from the battery to AC so the transformer can operate.

The normally-open momentary switch will convert the DC into a type of AC—but it won't be AC as we normally think of it. It will just be a current that alternates between on and off—not a nice, neat sine-wave. When you press the switch, current flows through the input side of the transformer, causing a magnetic field to build up. That *change* (from there being no field to the presence of one) induces a higher voltage on the output side.

Release the switch and the current stops. That causes the field to collapse. Because that is another change, it induces another shot of higher voltage at the output.

You can get pretty tired of pushing that switch. What you need is something to make and break the circuit for you. We'll substitute a relay for the switch, as shown

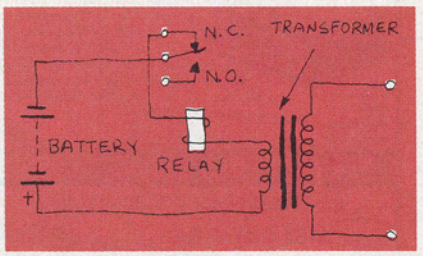

FIG. 2

in Fig. 2. When power is first applied, the relay contacts are closed and there is a current flow through the circuit—the relay coil and the input side of the transformer. The resulting magnetic field in the input winding induces a higher voltage in the output winding. At the same time, the magnetic field at the relay core pulls the armature and breaks the contact—it opens the switch and stops the current flow. That, of course, causes the magnetic field at the transformer to collapse, just as it did when you released the manual switch.

The magnetic field at the relay collapses, too, releasing the armature, which completes the circuit again. Thus, the cycle is repeated. The current starts and stops; the magnetic field builds up and collapses, and a shot of high voltage is produced at the output for each change.

The level of the output depends upon several factors. First, there is the ratio of output turns to input turns in the transformer. The higher the ratio, the higher the output voltage. Then, a higher battery voltage (and, thus, current) creates stronger fields, so the amount of change is greater and the output level increases. Finally, the faster the relay operates (within certain limits) the higher the output will be.

As far as parts selection is concerned, almost anything will do. I recall building this circuit when I was about your age, Eric. I used an audio transformer from an old radio and a door buzzer for the relay. I also remember getting shocked—but fortunately, the current was extremely low.

So I got shocked, but wasn't hurt. Be careful, though—don't tempt fate.

High current

George Santana (NJ) wrote in to describe his troubles with a stereo receiver. Briefly, it seems that the radio started cutting off and on for periods of 15 to 20 minutes, and later it began blowing fuses.

Well, I can't give George a definitive answer on his equipment, but thinking through some of the possibilities here may be of help to him now, and to you later, should you experience similar problems. His problem sounds like one bad component causing additional troubles.

Almost all modern equipment contains a *crowbar* circuit of one sort or another. That is nothing but an automatic switch that shuts down the power supply when either too much current is drawn and/or the equipment overheats. It closes everything down before the unusual condition causes more serious problems.

The crowbar circuit may be a discrete circuit in or near the power supply or it may be built into one of the components. Many solid-state voltage regulators have built-in protective circuits. When the power supply cuts off, something's wrong and the equipment should not be used until the problem is found and corrected.

George's description of the on-again, off-again receiver surely sounds like a protective crowbar-circuit in an overcurrent/overheated condition.

Let's suppose that—unnoticed as time goes by—papers and books and whatever get stacked up around and on top of a piece of gear. That could prevent proper circulation of air around the components, and poor ventilation will produce high temperatures—sometimes high enough to trigger the crowbar.

It is more likely, however, that another component has changed value or has failed altogether. When that happens, it can cause a change in current—it may increase or decrease. The latter situation does not activate the protective circuit, but it makes its presence known by changing the way the equipment operates.

In this case, I suspect that a component change has caused an increase in current (and heat). That would cause the crowbar circuit to cut the power. Later, when things have cooled down, the crowbar circut allows the power to return. If permitted to, that cycle repeats until there is more serious component damage.

What do you do when things have reached that stage? First, I would look for a short, and then for a component that has changed appearance. Specifically, I'd examine the resistors in a power stage—they are frequent culprits. If one shows signs of having overheated (it will probably look darker than the others) you may have found the problem.

If that test fails, you can begin measuring component values and testing transistors. An alternative is to "bull" your way, and turn the equipment on to see whether you can find a part other than the crowbar device that gets too warm—or *hot*! That's called the burned-finger test. If a component is too hot to keep your finger on it, there's something wrong.

The next procedure would be to measure the voltages at various points. Those values are compared with the normal ones (information provided by the manufacturer) or, lacking that information, with what you think should be normal at those particular points. If the gear won't operate so that voltage measurements can be made, I would disconnect the various stages of the circuit and then connect them one at a time until I got to the one that triggered the crowbar circuit.

There's nothing really scientific in all that, except for the thought process. The object is to identify the faulty part. If you can't spot it right off, then narrow down the possibilities until it is located. That approach applies not only to George's receiver, but to troubleshooting any piece of gear—electronic or otherwise.

An invitation

The mailbox is waiting; What would you like to know? Send me a question and I'll see if I can find the answer. **R-E**