HOBBY CORNER

Homemade remote sensors for your home weather-station.

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

JUDGING BY THE MAIL, THERE IS AN INcreasing interest in, and concern about, the weather—what it is, what it was, and what it will be. One reason for that concern may be the high cost of energy for heating and cooling, and how weather effects those costs. In any event, I've received many questions concerning electronic weather-instruments recently.

Your questions seem to indicate that the main problem is devising sensors or detectors. Most of you know how to evaluate a signal and display the result, but you need something that will generate the signal in the first place.

The first thing that I think of when I hear the words "weather instrument" is an anemometer (an instrument that measures wind speed and force) whirling around. There are, of course, several types of devices that can be used to indicate how hard the wind is blowing. Some of them are shown in Fig. 1.

A simple wind paddle attached to the shaft of a potentiometer is shown in Fig. 1-a. When the wind blows, its force pushes the paddle back, turning the shaft of the pot. That, of course, raises (or lowers) the resistance betwen the wiper and one end of the pot. The harder the wind blows, the higher (or lower) the resistance. It's a simple matter to measure the resistance from a remote location.

Figure 1-b shows a propeller attached to the shaft of a small permanent-magnet motor. The wind turns the propeller, causing the motor to act as a generator and produce a voltage. The faster the propeller turns, the higher that voltage. Again, it is fairly easy to measure the voltage from a remote location.

The same motor is used in the devices shown in Figs. 1-c and 1-d. In Fig. 1-c, cup-shaped air scoops are attached to the motor's shaft as shown. Those scopes can be easily made from ping-pong balls that have been sliced in half or from panty-hose containers. A similar device using vertical disc-shaped airfoils in place of the scoops is shown in Fig. 1-d.

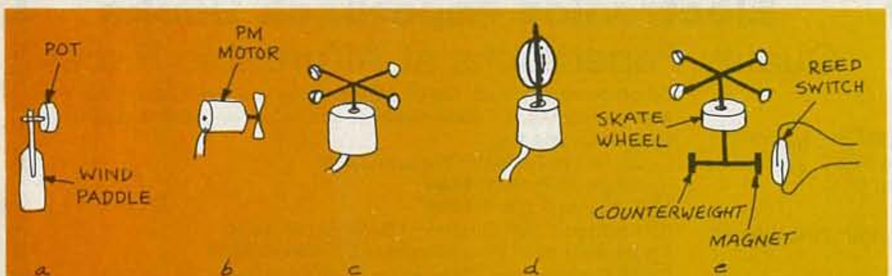

FIG. 1

In the device shown in Fig. 1-e, air scoops are used to rotate a free-turning shaft mounted in a roller-skate wheel. A counterbalanced crossbar with a permanent magnet on one end is attached to the shaft as shown. Each time the magnet passes a reed switch, that switch closes. The number of switch closures can be counted with a frequency counter or similar circuit and translated into wind speed.

A phototransistor can be used in place of the reed switch in Fig. 1-e. Replace the permanent magnet with a bit of reflective material. The phototransistor will generate a pulse each time the material passes it. (Of course, the sensor will not work at night unless you provide some illumination.)

Calibrating those devices can be a bit of a problem. The task is easy enough if you have access to a similar unit that is already calibrated—just match your readings to the ones it shows. But, since you probably won't be able to find a calibrated anemometer, you'll have to find another way. Perhaps the best method is to take the device for a ride in your car.

Pick a calm day, and get a friend to do the driving. Hold the sensor out the window, and drive up and down a road at several different speeds, calibrating your anemometer against the car's speedometer. To cancel the effect of any wind that may be present, drive both ways at each speed and average the readings you take. Using that method, you can calibrate your anemometer sensor at several wind speeds, and interpolate at others.

One more point before we go on. The sensors shown in Figs. 1-a and 1-b must be set on a vane so that they face into the wind. That could present a problem because the wires may wrap around the support and, for that reason, the other designs are more frequently used.

The next type of sensor, shown in Fig. 2, is used to determine wind direction. A standard wind vane, mounted on the shaft of a potentiometer, is shown in Fig. 2-a. The pot's resistance is used to indicate the wind direction. If you use that design, be sure the pot you choose can be taken apart so that the stop can be removed—you'll want the shaft to turn without restriction. Use a skate wheel as a thrust bearing.

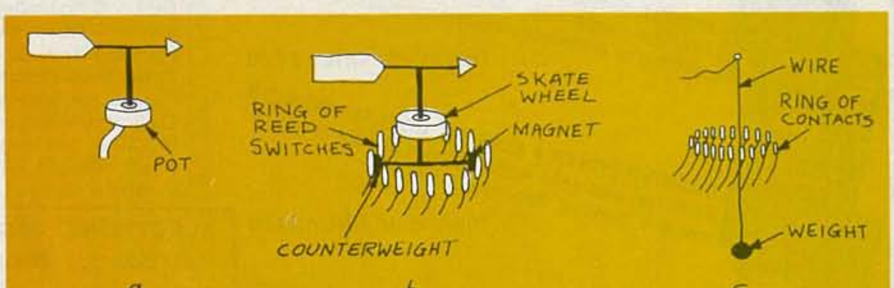

FIG. 2

The design shown in Fig. 2-b is similar to the one shown in Fig. 1-e for measuring wind speed. The difference is that this time there is a circle of reed switches; as before, one of the switches will close when the crossbar-mounted magnet is in its vicinity, thus indicating the wind direction. It's a simple matter to connect each switch to an LED or lamp to make a remote readout.

A less reliable—but less costly—way to determine wind direction is shown in Fig. 2-c. The weight is connected to a piece of bare wire that passes through a ring of contacts. When the wind blows, the wire will touch one of the contacts, completing a circuit.

The most expensive way to determine wind direction would be to use a pair of selsyns (DC remote-control devices that use the angular position of a shaft in the transmitter to control the position of an indicator in the receiver). Perhaps you can find surplus units.

Using a barometer to determine air pressure is the easiest of all. Since the pressure is the same inside the house as outside, a remote-reading instrument is not needed. Just keep a store-bought barometer on the shelf with your other weather equipment.

Designing a remote-reading rain gauge is quite another matter; the job can get quite involved. One possible design is shown in Fig. 3. A counterbalanced arm is mounted on the shaft of a potentiometer. A spring is used to hold an empty cup in the "zero" position. When it rains, water runs into the cup through the funnel. The weight of the water in the cup causes the pot's shaft to turn, changing the resistance of the pot, and the resistance measured can be converted into "inches of precipitation."

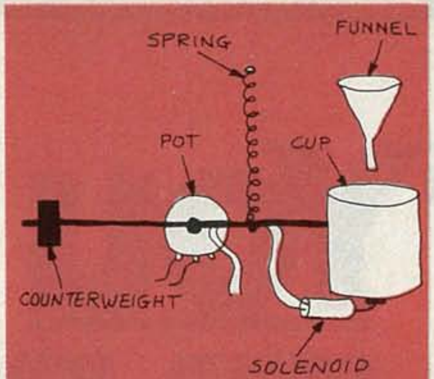

FIG. 3

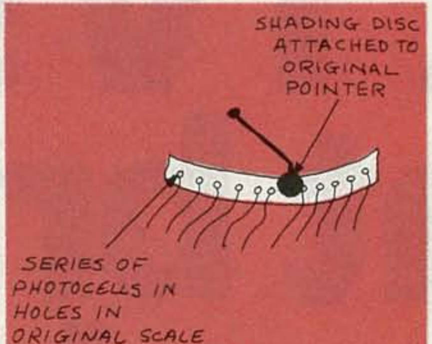

FIG. 4

The solenoid is used to empty the cup; it opens a drain hole in the bottom when a voltage is applied. Another way to empty the cup from a remote location is to use a solenoid to tilt the counterbalanced arm. In either case, this is a real "Rube Goldberg" affair. Perhaps you'd be better off just using a standard rain gauge and walking outside to read it.

Measuring air temperature is straightforward and many articles have been written about building remote-reading thermometers. In addition, many manufacturers offer electronic kits for that purpose. There is also the older, non-electronic, type of remote-reading thermometer that has a capillary tube running outside.

A remote-reading hygrometer for measuring humidity is another instrument that will require some jury-rigging. About the best I can suggest is shown in Fig. 4. Take a standard dial-type hygrometer, replace the dial with photocells as shown, and attach a disc to the pointer. The disc will shade a photocell when it passes in front of it, making it possible to determine the pointer's position from a remote location.

An instrument that measures the amount of sunlight over a given period of time is shown in Fig. 5; it consists of a photoresistor connected to a counter through a threshold circuit. Whenever the sunlight reaches a predetermined level, the counter runs, giving you the hours (or any other convenient time unit) of sunshine since the last time the counter was reset. For accurate measurements, be sure to keep the photoresistor clean.

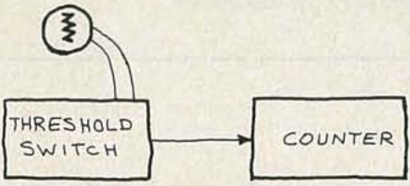

FIG. 5

That should keep you meterologists busy for a while. If you come up with any other ideas, or improvements on the ones presented here, let me know and I'll pass them along.

Electronic hobby kits

The people at OK Machine and Tool Corp. (3455 Conner St., Bronx, NY 10475) have come up with five low-cost electronics kits that I'm sure you will find quite interesting. You'll wind up with a useful device, and have an opportunity to learn something about electronics in the process.

The kits available are named: Quick Reaction (a game), Electronic Organ, Digital Roulette, Electronic Dice, and Morse Code Practice (an audio oscillator); each one sells for less than $15.00, and comes complete with everything except batteries and tools. The plastic packages the kits come in double as cases for the projects. The instructions are detailed and clear, and even a first-time builder should have little trouble completing any of the kits.

Do you know a young person who you would like to nudge into electronics? You won't find a better way than to present him (or her) with one or more of those kits. An assembled kit may be appropriate for a younger child. The roulette and dice devices can be used with other games, and seeing the internal parts is sure to arouse the child's curiosity. **R-E**

"Sometimes I wish you collected stamps, like other men."