BY CARL J. BERGQUIST

Special Effects with a Galvanic Coil

WHEN LASER-LIGHT EFFECTS ARE WHAT YOU WANT TO PRODUCE, ANOTHER USEFUL COMPONENT TO HAVE IS A GALVANIC COIL OR GALVANOMETER. THE GALVANOMETER IS A DEVICE THAT IS USED TO MEASURE THE FLOW OF ELECTRIC CURrent. You can make a simple one by winding 40 or 50 turns of magnet wire around a compass, in a north/south direction. When a voltage is applied to the coil, the compass pointer will swing from the north position to either east or west.

The same effect can be obtained by placing an external coil next to the compass at the east or west position. An applied voltage will then pull the compass pointer to the coil. You can use this principle to create an oscillation effect, which can be used effectively in light shows; in fact, it is the basis for many of the commercial light-show machines. The principle is simple: Feed a modulated voltage to the galvanometer coil, and the pointer movement will follow the signal or data being introduced in much the same way the laser flickers from electronic modulation.

Building a Galvanometer

For our purposes, a compass is far too delicate to be of much use. The alternative is to build a galvanometer that has a more rugged pointer—one that will support a mirror. There are a couple of ways to do that. But first, we must remember that the compass pointer reacts to the electromagnet, or coil, because it is also magnetized. So the first step is to rig a magnetic field on a vertical shaft that will pivot back and forth. That field can be permanent or electric, depending on the need; the merits of each will be discussed later.

Next, an electromagnet has to be positioned perpendicular to the vertical field, and at a distance that will allow the first magnet to clear the second in a full swing. With both components in place, a current sent through the electromagnet will attract the opposite pole of the vertical magnet and bring it around. I know that this is a rather simplistic explanation, yet it is the physical principle that makes the galvanometer function, and makes it a useful tool for visual productions.

WARNING! ! !
This article deals with and involves subject matter and the use of materials and substances that may be hazardous to health and life. Do not attempt to implement or use the information contained herein unless you are experienced and skilled with respect to such subject matter, materials and substances. Neither the publisher nor the author make any representations as for the completeness or the accuracy of the information contained herein and disclaim any liability for damages or injuries, whether caused by or arising from the lack of completeness, inaccuracies of the information, misinterpretations of the directions, misapplication of the information or otherwise.

As mentioned before, the vertical field magnet could be either permanent or electric. A permanent magnet offers

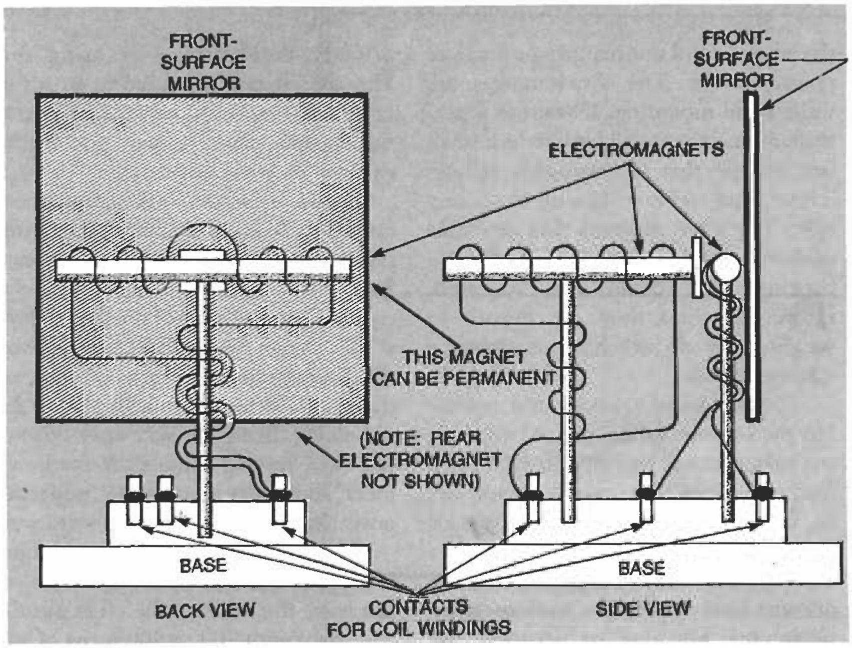

FIG. 1—A DETAILED LOOK AT A HOME-MADE galvanic-coil mirror assembly. It provides a great way to add a variety of movements to your light shows.

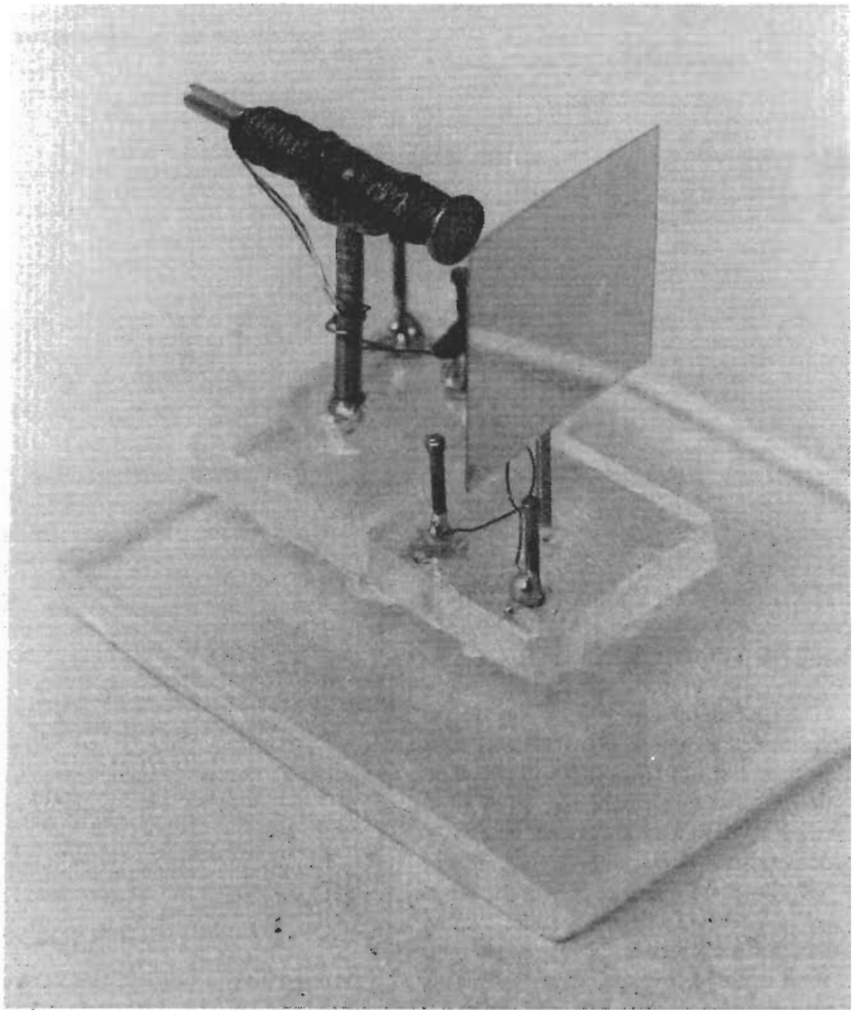

FIG. 2—THIS PHOTOGRAPH SHOWS the completed assembly. Note that the magnet-wire coils should be coated with glue or liquid rubber to hold them in place.

the advantage of not requiring a separate power source. The disadvantages are weight and mounting. If you use a permanent magnet, it will have to be a small bar magnet that is reasonably strong. Those tend to be a little on the heavy side. There are magnets that resemble rubberized strip material, with adhesive backing, that could also be used. However, while they are lighter in weight, they do not have as strong a magnetic field.

The next point to consider is mounting the magnet to the vertical shaft. In our unit, that will be a standard flat-head iron nail. Since permanent magnets can be damaged or destroyed by heat or shock, soldering, welding, or drilling a hole will not work. That leaves the use of some form of adhesive, such as epoxy, super glue, hot glue, or whatever else works for mounting.

The other alternative is an electromagnet. The power requirement is the primary disadvantage of using one. However, it can be turned to an advantage, since we could modulate the electromagnet's power source and further vary the patterns generated.

Figure 1 shows our galvanometer assembly. To build your own, start with a flat-top iron nail, and solder a second iron nail, with the top and point removed, to the head of the first to form a "T" shape. Using fine magnet wire, wind several hundred turns on the cross piece, and secure them with glue or liquid plastic. Bring the lead wires down to the base, leaving some slack for movement, and solder them to the connection posts. Again, small iron nails work well.

The second, or main, electromagnet is made in a similar fashion (though you can leave the head on the cross piece, if you wish) with 200 to 300 turns of wire on an iron nail. The coil is fixed in place with glue or plastic. The base that the magnets are attached to is made of wood or Plexiglas. A front-surface mirror is then attached to the vertical, or moving magnet, and the galvanic coil is ready for use. The photo in Fig. 2 shows the completed assembly.

In this configuration, the mirror will move on the X axis. To get Y-axis movement, merely turn the assembly on its side. Most of the commercial units, called scanners, use two coils, one for each axis. When connected to control circuitry, they develop an expansive variety of visual images.

Using the Galvanometer

Despite its relative simplicity, you can create a wide variety of visual effects with the equipment you have just made. The control circuit could be any audio source, including a portable-amp/microphone arrangement, or a pulse source for an established pattern. Figure 3 shows a simple pulse-generator circuit that could be used for that purpose.

When the signal from the control circuit is applied to the main electromagnet, the vertical field will be activated proportionally. That moves the mirror and creates the oscillation effect.

You could also use the galvanometer with one of the optical-table assemblies we built in the previous months. For example, Fig, 4 shows one such modification—in this case from the December, 1996 column—with our galvanometer used in place of a speaker modulator. The reflected image that appears on the screen should be a combination of that produced by the revolving mirrors and the oscillating pattern generated by the coil. The dual revolving mirrors could also be replaced with additional galvanometers. If you incorporate beam splitters, a single laser can supply the light for various galvanic coils to produce a maze of intricate images. At the risk of sounding redundant, the only limit to a dramatic world of visual imagery is your imagination.

Once the combinations have been tested and a favorite light-table assembly has been selected, try introducing special effects to the presentation. Colloidal suspensions such as smoke, fog, dry ice in water, or fine powders puffed into the air all produce a reflective surface for the laser beam and make it visible when it passes through them. By introducing the suspensions at strategic locations, you can add another dimension to the show. Reflecting the beam off the surface of moving liquids provides an excellent

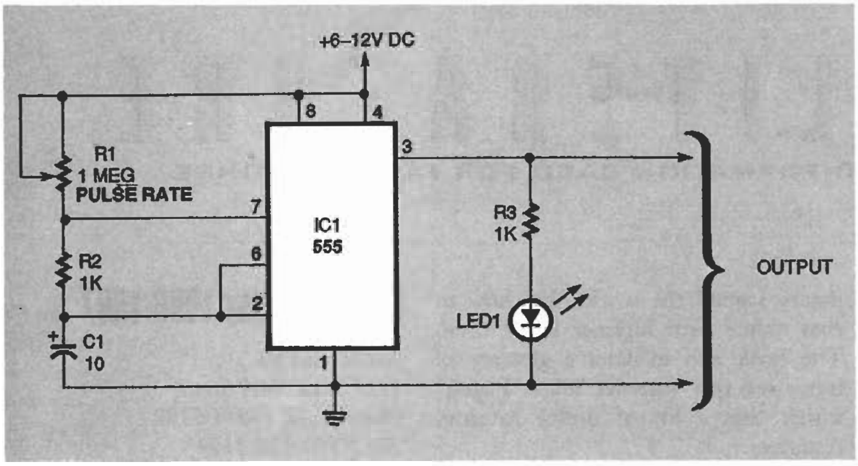

FIG. 3—THIS PULSE GENERATOR circuit could be used to drive the galvanic-coil/mirror assembly. Resistor R1 controls the pulse rate.

source of unexpected pattern variations. Try Mercury metal, if available, but be careful; it has a very high surface tension and will get away quite easily. That's why they call it quicksilver!

Warping the reflective surfaces is another method of obtaining weird fun-house effects that add spice to the production. Aluminized Mylar materials are especially suited to that application. High sensitivity luminous paints or tape can hold a trace of the beam for a short period of time and give some outstanding results. These are just a few of the ideas that come to mind at the mention of special effects. With some thought and general observation, many more will present themselves.

If you have some ideas of your own that you would like to share with other readers, please put them down on paper and send them to Laser Editor, **Electronics Now** Magazine, 500 Bi-County Blvd., Farmingdale, NY 11735, or via e-mail to lartonics@aol.com.

That wraps things up for this issue. Next time we will take a look at how you might use your laser to conduct scientific experiments or as the basis of fascinating science-fair projects. **EN**

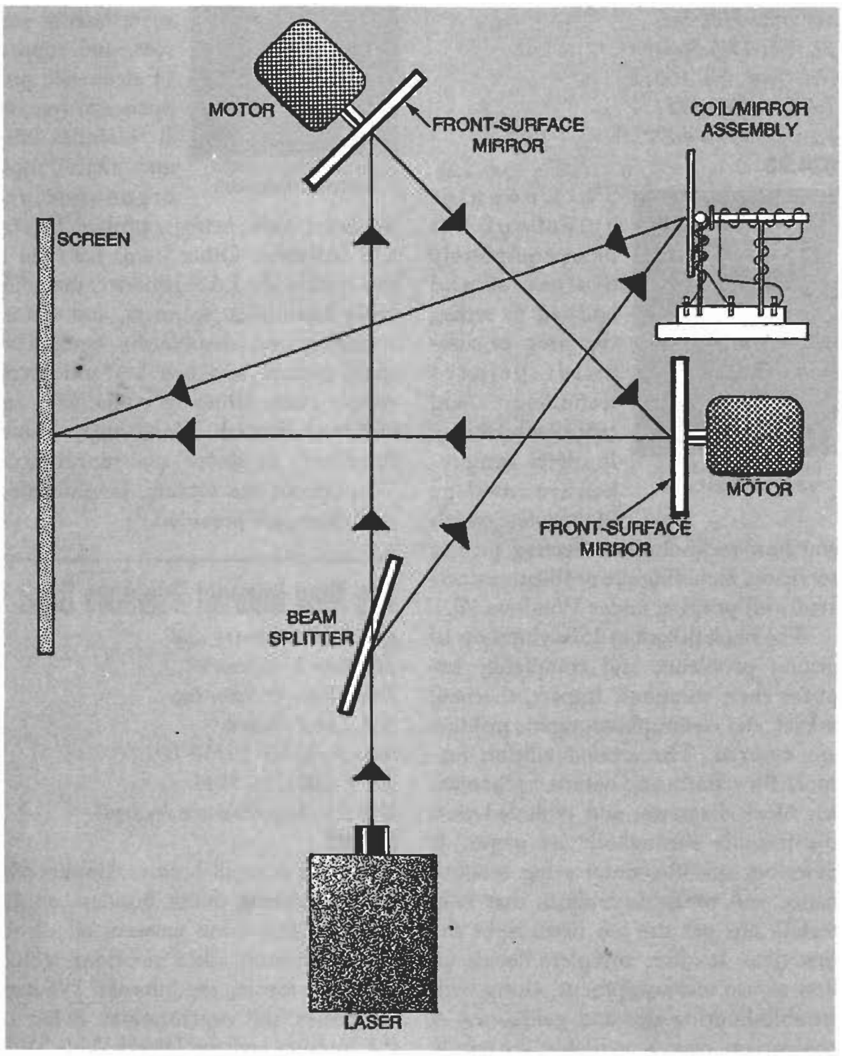

FIG. 4—HERE, THE GALVANIC-COIL ASSEMBLY has been combined with rotating mirrors and beam splitters to produce an intricate display. Note that the basic set-up was first presented in the December, 1996 issue; here a speaker modulator has been replaced with the galvanic assembly