

Visual Productions and Light Shows

LIGHTING IS NOTHING NEW TO THE ENTERTAINMENT INDUSTRY. SIMPLE CANDLE REFLECTORS, USED AS "FOOTLIGHTS", DATE BACK TO THE 1800s. WHENEVER NEW LIGHTING TECHNOLOGY CAME ALONG, IT WASN'T LONG BEFORE IT BECAME

a part of entertainment presentations. Few forms of lighting, however, have offered the versatility of laser light effects. The ability to effectively control

beams of light gives professional lighting technicians a tremendous edge over most other types of illumination.

Although dye lasers have been used in entertainment applications, this realm belongs almost exclusively to the gas lasers because of their visible beams of bright color. Copper-vapor tubes produce a pretty green with up to 150 milliwatts of power. Argon lasers emit anywhere from 10 milliwatts to 35 or 40 watts of blue. By using them with prisms or dichroic filters, other colors can also be produced. And don't forget the industry workhorse, the ruby-red helium neon, with outputs of 0.25 milliwatt to 25 or 30 milliwatts. Some HeNe tubes, due to an abnormal gas mixture, can produce 1 or 2 milliwatts of green radiance.

The choice of which type or combination of types to select depends upon a number of factors. The nature of the

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effects wanted, the intensity of the show, and the color or colors needed are all considerations, but the primary concern is probably going to be the size of the location where the production is to occur. For a small lounge or high-school dance, low-power lasers can be effective. However, when it comes to full-scale light shows, in large rooms or concert halls, there is little alternative to high-power argon tubes.

However, remember that those high-power units can be dangerous.

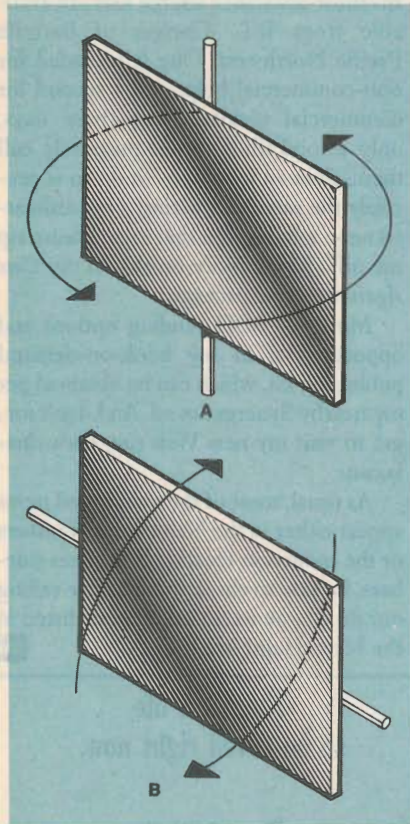


FIG. 1—X- AND Y-AXIS MOVEMENT is easy to understand. X axis movement revolves around the vertical plane—east to west (A); Y axis revolves around the horizontal plane—north to south (B).

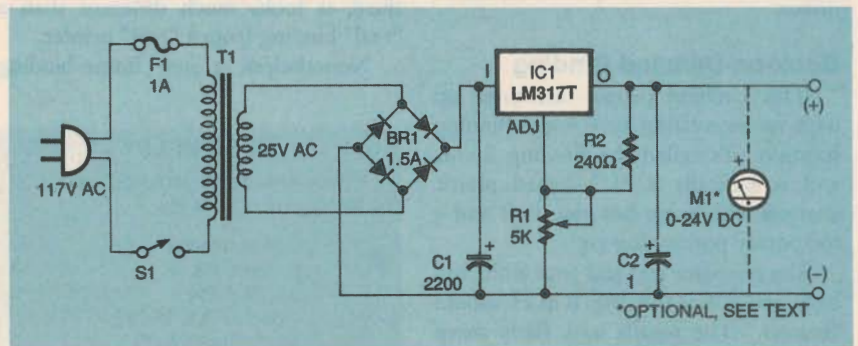


FIG. 2—A REGULATED VARIABLE-OUTPUT POWER SUPPLY is used to drive the mirror motors. Add a potentiometer in series with each motor to provide speed control.

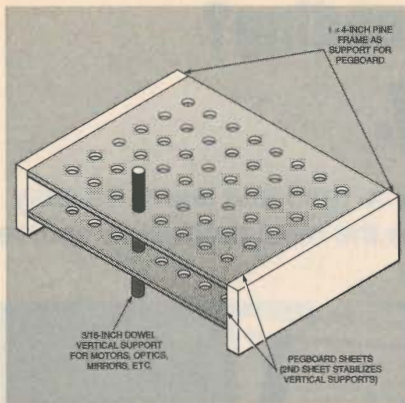


FIG. 3—YOU WILL NEED at least two of these optical tables. They are made from sheets of 3/16-inch pegboard and 1 × 4-inch pine. Be certain to align the holes in the two layers precisely.

There is an adage about peering directly into the beam of an argon laser. You'll only do it twice; once with each eye. So, if you work with argon lasers, a great deal of planning is needed in terms of beam direction, reflective surfaces, and optics, to keep the show safe for spectators, performers, and operators.

With that warning tucked away where you won't forget it, let's look at some of the ways exciting effects are obtained. We will explore simple equipment, and look at the principles behind sophisticated commercial machines. So let's get right to it.

Some Basics

The basis for any light-show equipment is a controlled method of moving and shaping the light. Throughout this discussion, references will be made to the X axis and Y axis. Those terms indicate the direction of the movement. Looking at a compass, X-axis motion is from east to west or west to east and is illustrated in Fig. 1A. The Y axis will be north to south or south to north and is shown in Fig. 1B. Movement around those axis can be continuous in one direction, oscillate back and forth, or be a combination of both, depending on the desired effect. As a general rule, motion on the X-axis produces a horizontal line, bar, or sheet of light. Y-axis motion produces the same effect, but on a vertical plane. Experiment with rotating the X axis and Y axis individually to be sure you understand the basic principles before moving on to the first practical assembly.

Controlling the speed of movement has an additional influence on the visual image. For example, reflecting the beam

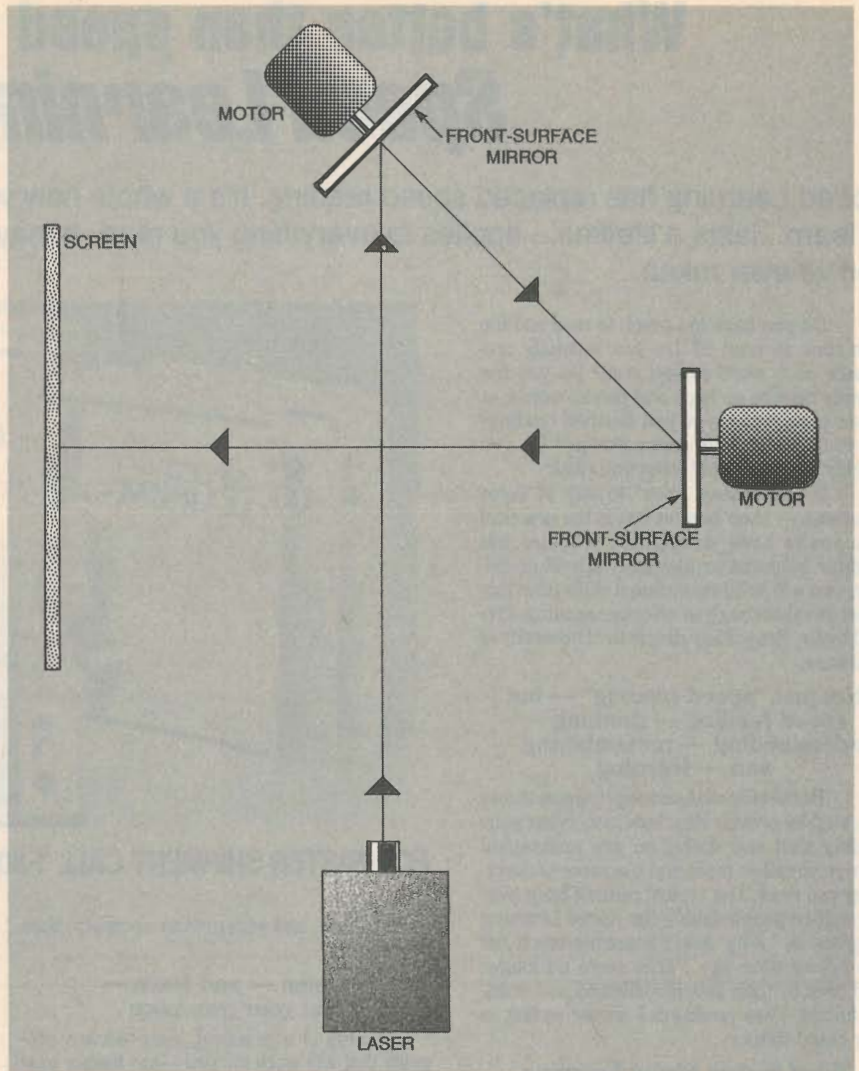


FIG. 4—A BASIC PATTERN-GENERATING setup is shown here. Two rotating mirrors are used. One affects the horizontal movement of the laser beam, the other the vertical movement.

into a very slowly revolving mirror will create a "dashing line" effect. As the speed of rotation is increased, the line will become solid. Aiming the laser at a mirror revolving in a circle will produce a circle or oval, depending on the angle of incident.

Speed can be controlled with commercial electronic units, but you can get acceptable results with the adjustable-output regulated power supply shown in Fig. 2. That power supply produces a very stable voltage output that can be varied between 1.2- to 24-volts DC by R2. Potentiometers, wired in series with the motors but not shown in the diagram, are used to regulate the speed; they work by varying the voltage to the motor. The system is efficient and inexpensive, and the regulated power supply could be useful in a number of other applications.

The Optical Table

Before going further, you will need to build a couple of simple optical tables. Don't worry if you are inexperienced with woodworking as they are easy to make. Use standard pegboard (3/16-inch holes) and pieces of 1 × 4 pine (see Fig. 3). The smaller table should be 12 × 20 inches, and the larger one 24 × 30 or 36 inches. Between the two you should have all the room you'll need to set up the optics, motors, etc. needed for the various demonstrations.

Note that two sheets of pegboard are used for each table. The top one acts as a guide, and the lower sheet stabilizes the vertical supports. For that to work properly, you must line up the holes in both sheets precisely and maintain accurate right angles. Use 3/16-inch wood dowels for many of the supports; they are inexpensive and easy to work with.

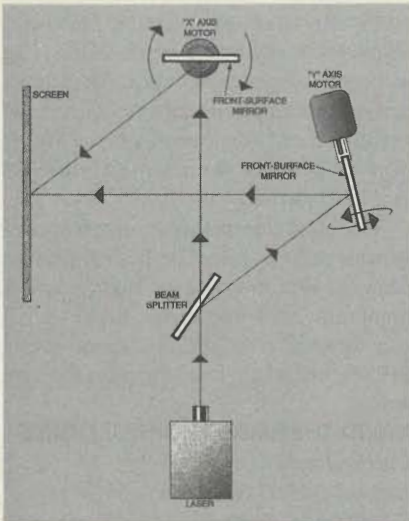


FIG. 5—INSERTING A BEAM-SPLITTER further enhances the variety of light patterns that you can create.

The height of a particular component can be adjusted by raising or lowering the dowel. You will find these tables handy when we explore holographic and scientific experiments later on in this series.

Some Experiments

The first, and simplest, assembly uses two motors. Each one has a round front-surface mirror mounted perpendicular to its shaft. Align the first mirror at about a 45-degree angle to the laser beam so that it reflects to the second mirror, positioned parallel to the beam. Figure 4 shows the correct orientation. The reflection from the second mirror projects back across the laser beam onto a screen made from an 8 × 10-inch sheet of cardboard with a sheet of white paper glued onto it.

With everything arranged as shown and the laser turned on, start one of the motors. A laser-light circle will appear on the screen. Next, adjust the angle of the motor, and watch how the circle shape becomes an oval. Now, start the second motor. A second, out of sync, circle will join the first, producing a “spirographic” effect on the screen. Add a 10,000-ohm potentiometer in series with each motor, and use them to vary the speeds of rotation. As you do, the pattern created on the screen will vary, providing a wide range of patterns.

While that is a very simple assembly, it provides the basics for more complicated layouts that will produce a fascinating number of pattern variations. For an immediate application, merely remove the screen, and aim the table,

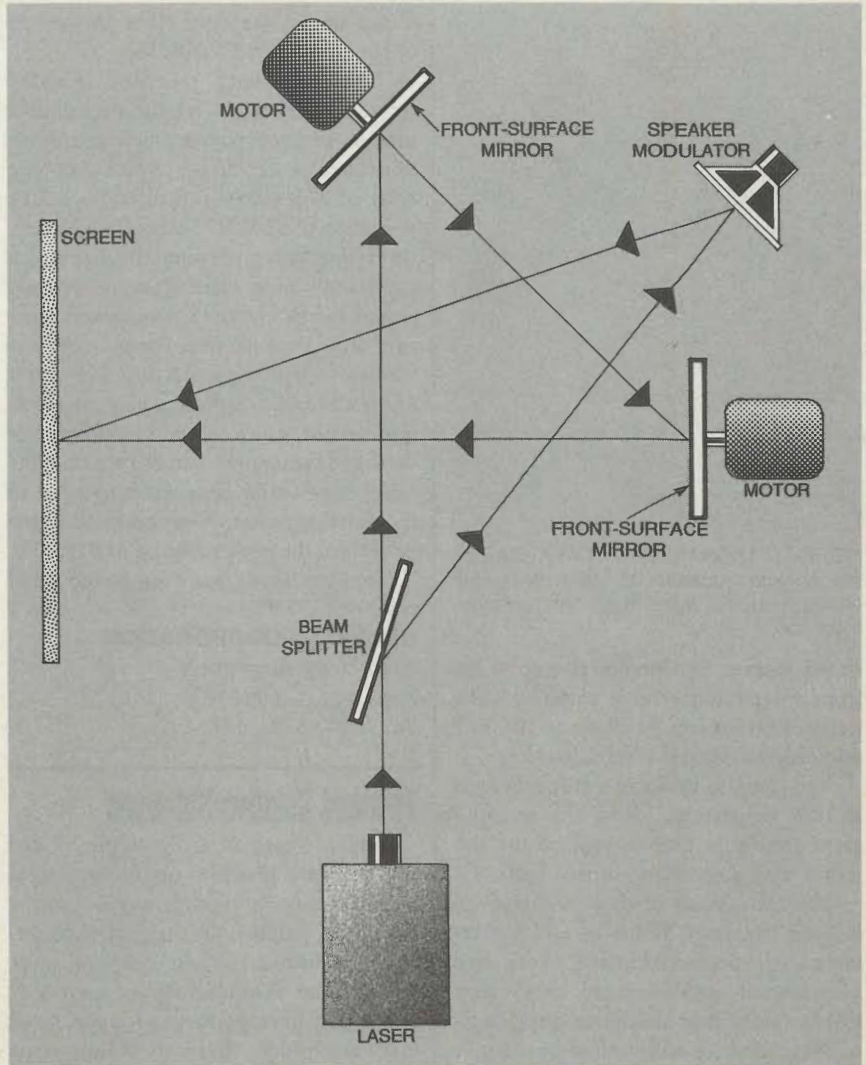


FIG. 6—COMBINING THE BEAM-SPLITTER with a speaker modulator produces an even greater variety of light patterns to add to your repertoire.

laser, motors, and all, at a nearby wall or ceiling.

For a second experiment, we'll go to the X/Y-axis concept. Figure 5 shows a layout using two motors; one rotating a mirror on the X axis and the second on the Y axis. A 50/50 beam splitter sends half the laser beam to the first mirror, and the rest to the other mirror. The two beams come back together at the screen, restoring the original intensity. When both motors turn at the same speed and the mirrors are in a vertical position, the projected laser light will form a solid cross.

If the X-axis mirror is angled to one side or the other, the line will follow the angle, and the image will change to a vertical line with a diagonal. Angling the Y-axis mirror will result in a similar variation of the vertical plane, and further distort the original cross. Now, slow one of the motors down. The line that it creates

will become broken or dashed, giving you another distinctive pattern. It is easy to see the numerous kinds and varieties of patterns that you can create by simply changing motor speed and mirror angle.

After you have run this setup through its patterns, you can add a second beam splitter and a speaker (used as a modulator), for another way to modify the patterns you produce on the screen. Figure 6 shows how that is done. Now the graphics you can create will include not only the spirographic designs, but a synchronized audio pattern as well. That third dimension is particularly effective when music is involved, as it provides continuous spiral patterns accented by the music's beat.

The beam splitter can be a 50/50 type that divides the light equally, or some other ratio, such as a 30/70, 40/60, etc. You can connect the speaker/modulator to a spare monitor output from the

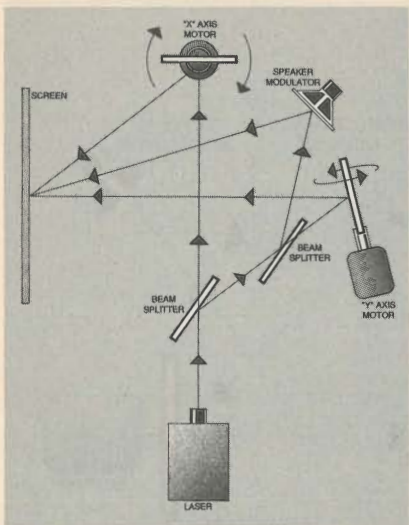


FIG. 7—IT MIGHT LOOK COMPLICATED, but as you continue to work with light effects, you will want to try this arrangement, too.

sound source. Optionally, it can be fed from a separate portable amplifier. The same additions can be made to the X/Y assembly for similar effects (see Fig. 7).

You can also make use of mechanical pattern generators. Using the arrangement shown in Fig. 6, replace the top motor with a revolving mirror ball.

You can use all of those methods of moving the laser beam to add excitement to the projected image. Work with a variety of combinations; the results will be fascinating and quite surprising.

Next time we will look at how a galvanometer coil can be added to your bag of tricks to provide an ever greater and perhaps more interesting variety of laser-light effects. Before you know it, you'll be producing outstanding light shows of your own.