Lasers And Coherent Light Essay, Research Paper

A laser (LAY zuhr) is a device that produces a very narrow beam of light. This is called coherent light. It is formed from producing light at equal wavelengths in phase. The result is a beam of light that does not stray from it?s path. Conventional light bulbs produce incoherent light. This form of light diffuses immediately upon radiation from its source. The size of a laser beam varies greatly. Some lasers produce beams that are small enough to fit 200 beams in an area the size of a pinhead.

The process of Light Amplification by Stimulation Emission of Radiation (LASER) was not conceived before the 1900?s because of scientist?s lack of knowledge about stimulated emission. The process of stimulated emission was first described by Albert Einstein in 1917. The idea lacked further development until 1954 when Charles Townes created a population inversion in a device that amplified microwaves. This device was called a maser (Microwave Amplification by Stimulated Emission of Radiation). Only a few years later, researchers proposed designs for devices that would amplify radiation in the visible light band. In 1960, Theodore Maiman constructed the first laser; it used a ruby rod as its active medium. The Gas, Dye, and Semiconductor varieties of lasers were constructed.

Laser beams carry with them a large amount of energy. At first, lasers were very large and very weak. Many scientists called them the “solution without a problem.” As lasers developed from their original state, they have provided modern science with many tools that cannot be derived from any other source. Modern lasers have the power to trigger small nuclear reactions, cut diamonds, weld metal, and alter human flesh. Less powerful lasers can also be used for digital data entry and retrieval, a task not easily performed by anything else.

Lasers can be used to “paint” targets and lead missles to their targets. They also can read bar codes and digital information on a compact disc. One use that has been implemented by the government is the laser microphone. The laser mike uses a beam to reflect off a window back to a demodulator. This can actually “read” the glass and pick up the vibrations that are created by people speaking near it.

There are currently four main types of lasers: solid-state lasers, semiconductor lasers, gas lasers, and dye lasers. Each of these lasers has three main parts. The first is an energy source. This is either electrical current, heat, light, etc. The second is a substance called the active medium. This substance provided atoms that will release energy. The last part is called the optical cavity or resonator. This is an area where the active medium is held. On either side of the optical cavity, there are mirrors. One of the mirror has a 100% reflection factor. The other mirror is mostly reflective but will let strong light through. When stimulated emission begins, the energy source causes the active medium to produce a photon. This photon is reflected by one of the mirrors in the optical cavity and strikes the active medium again. This results in the release of another photon. This process is a chain reaction that begins to produce a very bright light (abundance of photons). When the light reaches a certain intensity, it is released in a narrow beam through the partially mirrored side of the optical cavity.

The characteristics of laser light create the separation from normal light. There are two rules the light must follow to be characterized as coherent light. The first is it has very low divergence (separation). The second is that it must be monochromatic. Incoherent light diverges very quickly. A typical beam of coherent light diverges at a rate of 64 inches per mile or 1 meter per 1 kilometer. This property of lasers to cross great distances with very little power loss creates many new communication possibilities.

The ability of laser light to travel so far with such little divergence is from its emission of a very narrow band of wavelengths. Ordinary incoherent light is composed of many different wavelengths of light. Each of these wavelengths are not in phase with each other and therefore are destructive. The destructive waves cause each individual wavelength to bounce off another and in turn becomes diffuse. Laser light is composed of only a few wavelengths that are very closely matched and emitted in phase. This reduces its tendency to become destructive and diverge.

Lasers, no matter which type, can be operated in 2 ways. These are: continuous wave and pulsed. Continuous wave lasers cannot achieve the same peak output power as that of a pulsed laser. Most continuous lasers range in power from 1/1000th of a watt to more that 10,000 watts. Pulsed lasers can produce beams with an output level of several trillion watts.

Solid-state lasers use a solid rod of crystal or glass as their active medium. They use flash lamps as their energy source to induce the chain reaction.

Semiconductor lasers include compounds of gallium, indium, and arsenic. The semiconductor in a laser consists of two layers that differ in their electrical properties. The junction between the layers is the active medium. When current flows between the two layers, stimulated emission begins in the junction area; the flat ends of the semiconductor serve as the mirrors on the optical cavity. Semiconductor lasers are the smallest kind; some are smaller than a grain of sand. This type of laser is used in CD and laserdisc players because of their incredibly small size.

Gas lasers use a gas or mixture of gases in a tube as the active medium. Some of the gases used for this purpose are: CO2, Argon, Krypton, and Neon. The gas is stimulated by an electrode. This method for stimulation gas particles is also used in gas lights such as Fluorescent light bulbs and Neon signs. Gas lasers are often used to produce infrared beams. The CO2 variety is one of the most efficient and powerful lasers. CO2 lasers convert 5 to 30 percent of the energy from their source into laser light. Most other lasers only convert about 1% of their power into light. Gas lasers are used mainly for cutting and wielding metal, communications, surgery, and entertainment.

Dye lasers use a dye as the active medium. Dye, dissolved in a liquid (usually alcohol), is stimulated into emission by another laser. Dye lasers are very useful when the task requires a tunable laser. This means that the laser is capable of being configured to produce a monochromatic laser beam on a variety of wavelengths (i.e. The color can easily be changed). Dye lasers are often used in the study of how materials absorb light.

Lasers can be used in digital data entry and retrieval. The Compact Disc player is one of the most prominently used lasers in common society. The CD player produces a laser beam that it directs at the Disc. The disc?s encoding is the use of very small divets in an aluminum sleeve. The laser is reflected off these bits on to a collector. Depending on how the laser is received, the collector interprets a 1 or 0 (on or off). The ones and zeros are used to produce an analog signal by using a D/A conversion algorithm. The bar code concept is very similar to that of the compact disc. The laser is run across a series of black lines. The reflected laser light is again received on a collector and converted to an analog signal. This can then be matched with a table of values and identified.

Lasers, when used in surgery, can be very useful in the cutting and attaching of flesh. A laser beam can be used to produce a very fine incision, therefore reducing the amount of traumatized tissue and size of a scar. Weaker, more diffuse lasers can be used to “melt” flesh together. This reduces the need for sutures and staples, again reducing the long-term cosmetic effect of a large scar.

Lasers have come a long way since their conception. They have provided us with many tools unique to coherent light technology that have changed our world.