LASER PROGRAMME

CO_2 Surgical Laser System

A prototype 40 W carbon dioxide surgical laser system (model C-40) has been developed. This system was handed over to Choithram Hospital and Research Centre, Indore by Dr. P K Iyengar,Chairman, Atomic Energy Commission (AEC), on May 26, 1990.

The system consists of a carbon dioxide laser head which can deliver upto 70 W cw power. The red He-Ne laser beam is combined with the CO_2 laser beam to locate site of focus of the beam. A seven jointed articulated arm is used for transporting the combined beam to the site of operation. This arm provides a smooth three dimensional motion of the laser beam and enables the surgeon to effortlessly guide the beam to the desired place. At the end of this arm, a tip incorporating a lens is attached to focus the laser beam.

The system has a self-contained chiller unit and a fully automatic, sequentially interlocked control system to provide safety to the user and the system. All the control operations and the measurements can be performed on a small portable console module which can be moved away upto 2 meters from the main unit. Other features of this system include a 1.2 meter working radius, 40 W cw power at the site of operation and laser beam focal spot diameter of about 300 microns.

After extensive trials on animals, the prototype laser has been used successfully, in December 1990, at Choithram Hospital and Research Centre, Indore on two patients with disorder of vocal chord. This laser surgical system has potential applications in many other fields like Gynaecology, Oncology, Neuro-surgery, Dermatology and Gastroenterology.

High Power Multibeam CO_2 Laser

A slow flow cw CO_2 laser giving 500 W output power has been developed. In a slow flow CO_2 laser, typically 50 W of laser power can be achieved per meter length of the active medium. Therefore, to obtain 500 W power, a system consisting of four independent parallel lasers, each of an active length of 2.5 m was constructed. All the four lasers share the same resonator, consisting of a plane zinc selenide output coupler of 50 mm diameter, 70% reflectivity and a 98% reflecting plane molybdenum mirror. Both the mirrors are water cooled.

The system operates with an optimum gas mixture of CO_2:N_2:He in the proportion of 1:1.5:6 and a rotary pump of 50 LPM capacity is used for flowing the gas mixture through plasma tubes. Electrical discharge in the plasma tubes is initiated using a 25kV, 500 mA DC power supply. To reduce the high voltage requirements and also to permit safe handling of mirrors, the discharge length in each plasma tube is divided into two equal parts. Further the cathodes at the two extremes of the laser are electrically grounded. Simultaneous striking of electrical discharge in all the limbs has been a major problem and is solved by applying a high voltage pulse of 15 kV and 200μs rise time, generated by a stack of SCRs operated in self breakdown mode.

The slow flow system developed at CAT is considerably simpler and cheaper compared to similar systems based on alternate technologies employing expensive blowers and heat exchangers. It is particularly suited for applications requiring CO_2 laser power of upto 1 kW beyond which scaling of this system will be cumbersome. This laser will be coupled to a microprocessor controlled work table and used for industrial applications like surface hardening, drilling and welding.

Laser Power Meter

Laser power meters are much in demand due to widespread use of lasers in research and industry. Hitherto most of the power meters used in our country have been imported. In order to meet this demand indigenously, efforts were initiated at CAT to develop laser power meters. A prototype power meter capable of measuring cw power upto 30 W has now been developed.

In the power meter developed at CAT, laser radiation falls on a black anodised aluminum absorber disc. Nearly complete absorption of light energy is achieved by providing knurled grooves on the surface of the disc facilitating multiple incidences. The disc is connected to an appropriate heat sink establishing thermal gradients which are sensed by a thermopile. The system is designed to provide a steady state time response of less than 1 second.

The power meter has a measured detection sensitivity of 0.07 mV/W, which is linear with the input laser power and does not vary appreciably with the beam spot size.

COVER: *Dr. D D Bhawalkar, Director, CAT demonstrating the operation of the surgical CO_2 laser system developed at CAT at a function organised to hand over the system to Choithram Hospital and Research Centre, Indore. Dr. P K Iyengar, Chairman, AEC (extreme left) formally handed over the system to Dr. N S Bhagwanani, Medical Director, Choithram Hospital and Research Centre, Indore (extreme right).*