Scale unit : The scale mounted detector unit is a laser sensor, which indicates the position of the scanned laser beam from the scanner unit by buzzer as well as on a LCD display. The unit is mounted on a measuring shaft, which indicates the local height at that place. The unit is shown mounted on a measuring shaft in fig.L.2.1 (b). This unit is used for surveying the land before leveling. This method of surveying requires only one person to carry the measuring shaft around and measure the height at various places, unlike surveying with a theodolite system where two persons are required, one for holding the measuring shaft and another to read the elevation from the theodolite. The scale unit measures 60mm x 110mm x 25mm and runs on a 9V alkaline battery.

Scrapper controller: This unit consists of a scrapper-mounted detector and a control box for controlling the scrapper hydraulics through a solenoid operated flow valve. Fig. L.2.2 shows the detector and the control box.

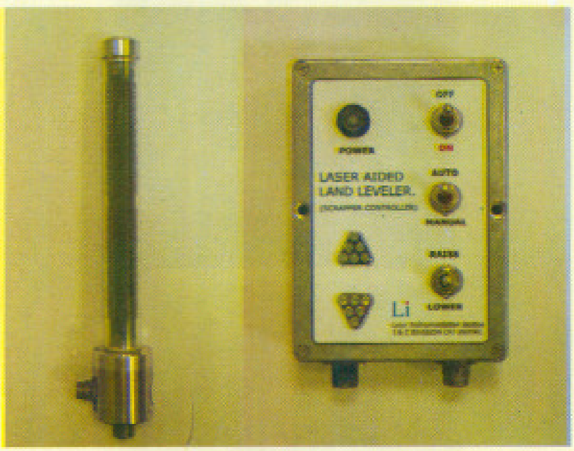

Fig. L.2. 2 Scrapper controller unit

The detector mounted on the scrapper bucket detects the position of the laser plane and the control box switches on the appropriate solenoid to raise or lower the bucket to maintain the laser plane centrally on the detector. As the tractor drags the scrapper bucket around, the control box maintains the scrapper height level with reference to the laser plane, this ensures that the scrapper cuts soil at high points and dumps at low points thus automatically leveling the field. The control unit runs on the 12V battery of the tractor. The control box provides indication of the laser plane position on the detector and also the direction of the scrapper movement. The control box also has a provision for manual override and for manually raising and lowering the scrapper bucket, which is required for sensor set-up, while traveling on the road.

A proof of principle system was developed and demonstrated at CIMMYT New Delhi in Feb 2003. This is a pre-production prototype that has been demonstrated at PUSA farms and CIMMYT New Delhi on 30^{th} June 2003.

(Reported by: Sendhil Raja S; sendhil@cat.ernet.in)

L.3 20kW CO_2 laser

High power CW CO_2 laser has been developed. More than 15kW of output power was obtained with about 15% electro-optic efficiency from two of its four discharge sections. This is the maximum cw laser power reported so far in an industrial CO_2 laser in the country. Work is on to extract laser power from all four-discharge sections in the oscillator-amplifier configuration. The unique feature of this laser is that this can be operated in four different modes, namely, (i) Continuous wave (ii) Pulse-periodic (iii) Process velocity dependent power ramping and (iv) Single-shot with variable ramping times mode. To achieve these features a high power programmable-switched mode power supply of 3.3kV, 9-85A, 280kW rating, which uses a multilevel four stage cascaded DC-DC converter, was especially designed and developed. Applications of this laser will include laser deep penetration welding, laser cladding of large area surfaces and concrete processing.

A rotating water cone calorimetric type power meter has been developed to measure CW CO_2 laser power in 1-20kW range (fig.L.3.1). Its response time is ~ 60sec. and response is almost linear for laser power up to 15kW with 7lpm water flow rate.

Several laser material processing experiments were done with the CW and pulsed CO_2 lasers and the full system is shown in fig. L.3.2. Cold rolled grain non-oriented (CRNGO) sheets of 0.5mm thickness were laser cut to develop scanning magnets of food irradiating electron beam system. Dimensional accuracy of the dross-free profiled cuts was within ±50microns limited by the CNC workstation accuracy. Near the laser cut edge there was no change of microstructure in terms of any phase transformation or grain growth, an important favorable factor for the magnet.

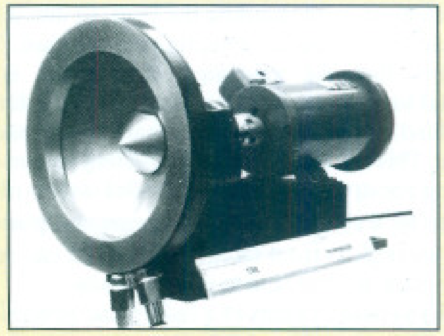

Fig. L.3.1 Rotating Water Cone Power Meter

Fig. L.3. 2 20 kW CW CO_2 Laser

(Reported by: A.K. Nath ; aknath@cat.ernet.in)

L.4 Laser based machine for Brachytherapy capsule welding

A laser based welding machine has been developed for welding of irradiation capsules (source), in a hot cell. At present these capsules are being welded by pulsed TIG welding machine that is not preferred any more for ensuring enhanced safety and reliability of source integrity over prolonged duration of use. TIG welding is not suitable for welding of small capsules (thin walled), in particular that of Cs-137 Brachytherapy sources. When these capsules are welded with TIG, due to over heating Cs-137 comes out of the capsules in the form of vapor during welding. The laser welding is the solution for such critical welding because with laser one can control and impart precise amount of thermal energy over a small area, which is just suitable for melting desired volume in a very small duration of time (few ms). Therefore total heat input to the job is minimum and bulk heating of job, to a high temperature, is avoided.

The machine consists of an Nd-YAG laser with fiber beam delivery system and a semi-automated laser welding workstation (see fig. L.4.1). The workstation consists of a job holding rotary fixture, driven by stepper motor, and a welding head. The jobholders (fixtures) are provided with precision sliding fit, with gearbox shaft and with the capsules. This is designed for ease of mounting and dismounting with the help of master slave manipulator (MSM) of hot cell. Two holders are designed for two different size capsules in such a way that welding plane is maintained with respect to cutting head (focus plane of the lens). Specially designed spring catches are provided, at both the locations, to avoid slip or movement between job and holder and also between holder and the shaft

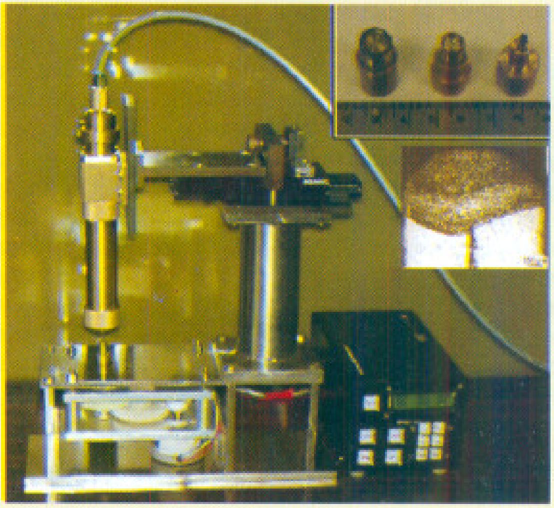

Fig. L.4.1 Capsule welding work station
(Inset- welded capsules & cross section of weld-ment).

The welding head is mounted on a precision slide. When the slide is at one extreme the welding head is just above the seam and is kept in the precise position by mechanical stopper cum magnetic catch. The welding head can be moved to other extreme of the slide to replace the new capsule assembly using MSM. One such machine is installed at BRIT, Mumbai, where regular production of capsules is being done.

(Reported by: T P S Nathan; nathan@cat.ernet.in)

L.5 Development of multirod CW Nd: YAG laser

The output power of a solid-state laser can be scaled to higher levels by using multirod systems. We have developed a CW dual cavity Nd:YAG laser capable of producing output power more than 570Watts. The gain module consists of 8mm dia. x 150mm long Nd:YAG crystal pumped by a single krypton arc lamp in a close coupled gold-plated elliptical reflectors geometry. The laser cavity and lamp is cooled by chilled de-ionized water using closed loop water chiller unit. The arc lamps are powered by