Inventing and Patenting on Lasers – An Overview

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This paper reviews the worldwide inventing activities on lasers and numerous applications of this technology. It covers the study of technological development, patent trends, likely technological trends, and indicators of R & D. Based on the patent analysis, efforts are made to review the technology trends in this field, patenting activity in different nations is compared, identified the institutions that are the loci of innovative activity in laser science and technology, market players are found out, comparison among the industrial firms is done, identified the sub-fields in which the patents are being filed, and areas of emphasis are determined.

The word laser is an acronym for light amplification by stimulated emission of radiation, although common usage today is to use the word as a noun — laser — rather than as an acronym — LASER1.

A laser is a device that creates and amplifies a narrow, intense beam of coherent light. The foundation for the discovery of laser can be traced back to the theory of stimulated emission of radiation by atoms proposed by Albert Einstein as early as in 1917. Einstein thus, can be considered to be the father of the laser2. However, Einstein’s idea became a practical reality only in the 1950, when Townes of the Columbia University (USA) conceived and built MASER, an acronym for microwave amplification by the stimulated emission of radiation.

The first detailed proposal for building a laser, known as optical maser at that time, was published by Schawlow and Townes3. The publication of the Schawlow and Townes paper and the work of Basov and Prokhorov of the LEBDEV Physics Institute of the erstwhile USSR spawned a race to build up and demonstrate the first laser.

Maiman5 at the Hughes Research Laboratory (USA) was the first who completed his
nine-month laser research programme and successfully produced laser beam using ruby as a medium on 16 May 1960. Soon after the discovery of ruby laser in 1960 there followed, in words of one observer “a tremendous explosion of publications on laser transitions in hundreds of different materials and on properties of laser devices”.

Applications of Laser

The unusual characteristics of laser light make it indispensable for a variety of applications. It is exceptionally monochromatic, very coherent and can be transmitted over great distances without the beam spreading. It also has the advantage that a lot of power can be concentrated in a very small area. These extraordinary characteristics of laser have found applications in different fields. Today more than 450 different applications \(^6\) of lasers exist, covering almost every field of human activity. There are perhaps only a handful of technologies in the twentieth century which have had as much impact on our lives as laser. Laser can be used for constructive as well as destructive purposes. Surgeons have got a very sharp instrument on one side and field marshall found a potential death ray on the other. Important areas of applications where laser find applications are all branches of engineering, medicine and surgery, and of course defence.

Patenting Activity in Lasers

To study the growth pattern of patent filed in USA, the data source used was the USPTO Web Patent Database\(^7\). The year-wise US patents on laser from 1990 to third October 2000 are presented in Table 1. The database was searched only using the word ‘laser’ in the titles of the patent document. There could be a few more patent documents on laser having titles without the world laser.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of patents</th>
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<tbody>
<tr>
<td>1990</td>
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<td>1997</td>
<td>797</td>
</tr>
<tr>
<td>1998</td>
<td>1,114</td>
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Technology Trends

Patents on laser are being filed in two different type of categories. One of them deals with the experimental aspects, while the other deals with applications of laser. In a study carried out by Garg and Padhi\(^8\) using the patents data included in the Journal of Current Laser Abstracts for 1970-1971, 1975-1976 and 1980-1985, it is observed that different aspects of the spectroscopy of laser output followed by physics and chemistry of laser materials and Opto-acoustic and thermal effects have received maximum emphasis in the experimental category.

Laser technology cuts across many fields and hence, it has emerged as a highly promising technology. In a study published in the Intellectual Property Rights\(^9\), numerous applications where patents have been filed are in the areas of production engineering, metal processing, workshop practices, construction, ranging, weapon guidance, beam weapons, navigation, communication, information processing, holography, teaching
and research, microprobe analysis, spectroscopy, plasma studies, medicine and surgery.

The maximum number of patents have been granted in the area of semiconductor laser followed by dye lasers, excimer lasers, free electron lasers, metal vapour lasers, X-ray lasers and photolytic iodine lasers. The semiconductor laser appears to have generated the maximum interest in the last two decades.

Another emerging technology relates to laser arrays that can simultaneously emit light of different wavelengths from different elements. These are useful in a variety of applications such as colour printing, full colour digital film recording, colour displays and other optical recording system applications.

As per patent literature, lately there has been much interest and success in the development of photolytic atomic iodine 1.315 micron lasers. However, the technology of the 21st century appears to be the X-ray laser. Patent literature predicts that an X-ray laser could be developed that would radiate at X-ray wavelengths of less than 5 Angstrom units.

Patenting Countries

Based on the above mentioned two studies it is observed that USA files the maximum number of patents followed by Japan, Germany, France, and England. The share of US patents is much higher than the patents filed by other countries.

Key Market Players

Lasers have a wide range of applications and have captured the interest of highly-funded organizations. Their utility has created a worldwide market for industrial system of about US $ 1000 million, and the same is growing at a rate of 14% per year. This has also instigated multinational organizations and US government agencies to undertake research in this front line area of science and technology. US government agencies involved in research are U.S. Navy, Army and the Air Force, besides US Department of Energy, and NASA. Other US multinationals include AT&T Bell Labs, Hughes Aircraft, Xerox Corporation, Eastman Kodak, Bell Communications, IBM, and American Optical Company. Leading multinationals from Japan are Matsushita, Nippon Electric Company, NEC Corporation, while from Germany Siemens AG, Thomson CSF and Compagnie Generale Electricite from France are the leading multinationals involved in the development of laser technology.

Indian Scenario

In India also the R & D efforts in the field of laser began fairly early. However, Bhabha Atomic Research Centre (BARC), Tromby, was the first to fabricate a gallium-arsenide laser as far back as 1964. This was used in 1965-66 to establish an optical communication link between BARC in Trombay and TIFR (Tata Institute Of Fundamental Research) in Colaba, a distance of 20 Kms.

These days the research work is mainly being carried out at University of Hyderabad, Bhabha Atomic Research Centre, Indian Institute of Science, Bangalore, IITs at New Delhi, Kanpur and Madras, and the Centre for Advanced Technology (CAT), Indore. However, the patents filed by Indian scientists as seen through JCLA are only from CAT.

Conclusion

The increase in the laser research has generated a burgeoning literature and a good
number of patents. USA and Japan are the leaders in patenting activity in this area. Among the institutions filing patents most of the industrial houses are from USA.

References

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