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Solar Beam Metal Welding

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***Abstract:** In the modern world, demand of energy is increasing and our conventional energy resources are depleting at high rate. Non-conventional energy resources or Renewable energy resources are capable to fulfil our energy requirements. Solar energy is a non-conventional energy resource having a high amount of energy. The solar energy falling on earth surface is now used in many ways by converting it into electrical energy by solar cells. This solar energy or radiation can be used directly for heating metal surface by focusing it at a point with some optical arrangements consisting convex lens, concave mirrors, parabolic mirrors etc. and can be converted into a beam like the laser beam or electron beam. This beam can be used for welding two pieces of metal. This welding can reduce the energy consumption from the electric grid. And this type of welding process does not release any harmful gases or waste at the time of operation.*

***Keywords**: Solar energy, Solar beam, Welding, Non-conventional energy, Laser welding, Electron beam welding.*

I. INTRODUCTION

Welding is an essential part of manufacturing. Welding of the metal requires a large amount of the energy to weld and also an increase in the operating costs. This energy problem can be solved by using the solar beam welding. Convex lens and parabolic mirror have a quality to converse the light, coming from infinity, at its focal point and also it can diverse the light coming from its focus. In solar beam welding, solar energy is collected by a big size convex lens and it is converted into a beam by a very small size convex lens or small parabolic mirror. Small lens or parabolic mirror makes the rays, coming from the its focus, parallel like a beam. When this concentrated light beam fall on a surface, temperature of surface starts increasing. This concentrated energy beam is used for welding. Optical fibre can be used to guide the solar beam towards the work piece for welding and this beam can also be focused on work piece by using a small focusing lens to reach high temperature and to reduce the heat affected zone.

II. SYSTEM LAYOUT

The layout of system may vary due to different optical devices but the principle remains same. There are some types of ray diagrams are given in figures. In the first figure convex lenses are used to turn the solar energy incident on big lens to a beam. And in the second figure parabolic mirrors are used to turn the solar radiation falling on the surface of the big parabolic mirror into a beam. Parabolic mirrors have good focusing properties than the convex lenses. This solar beam can be guided by optical fibres or wave guides towards the work piece for welding.

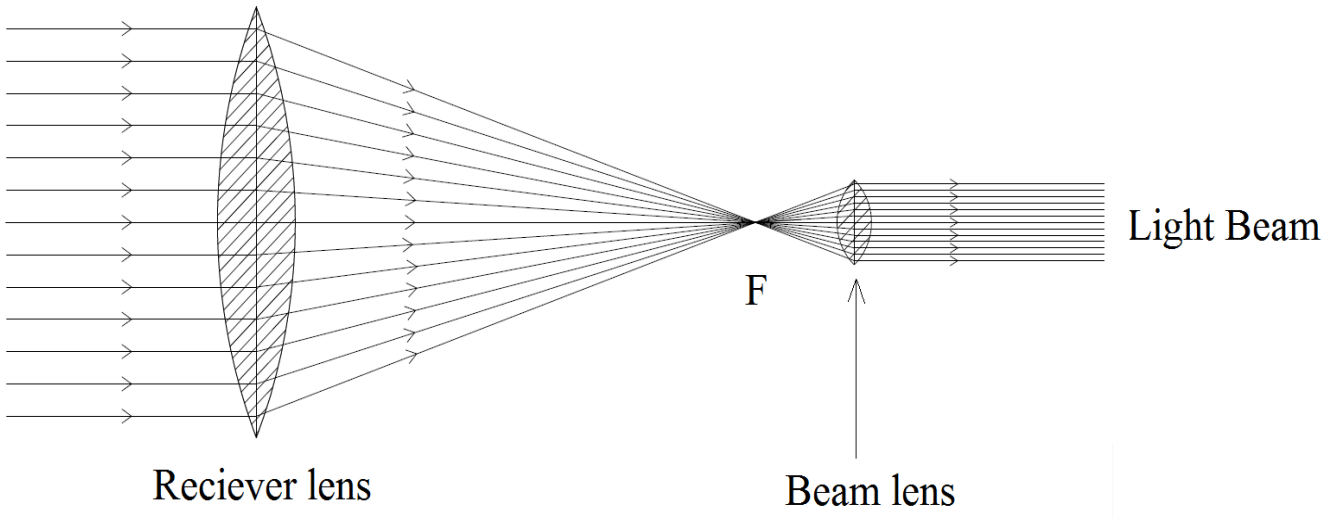

Fig. 1 Solar light turned into a beam by using two convex lenses.

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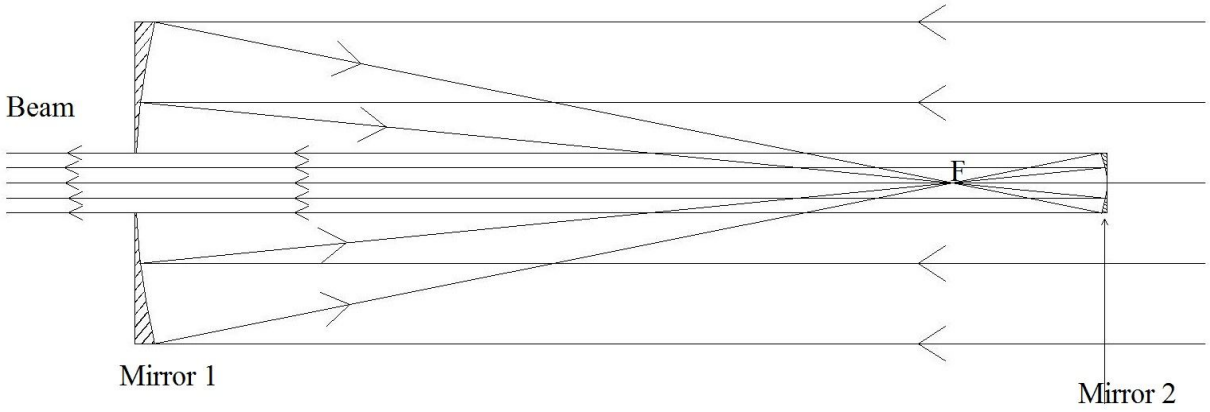

Fig. 2 solar light turned into solar beam by parabolic mirrors

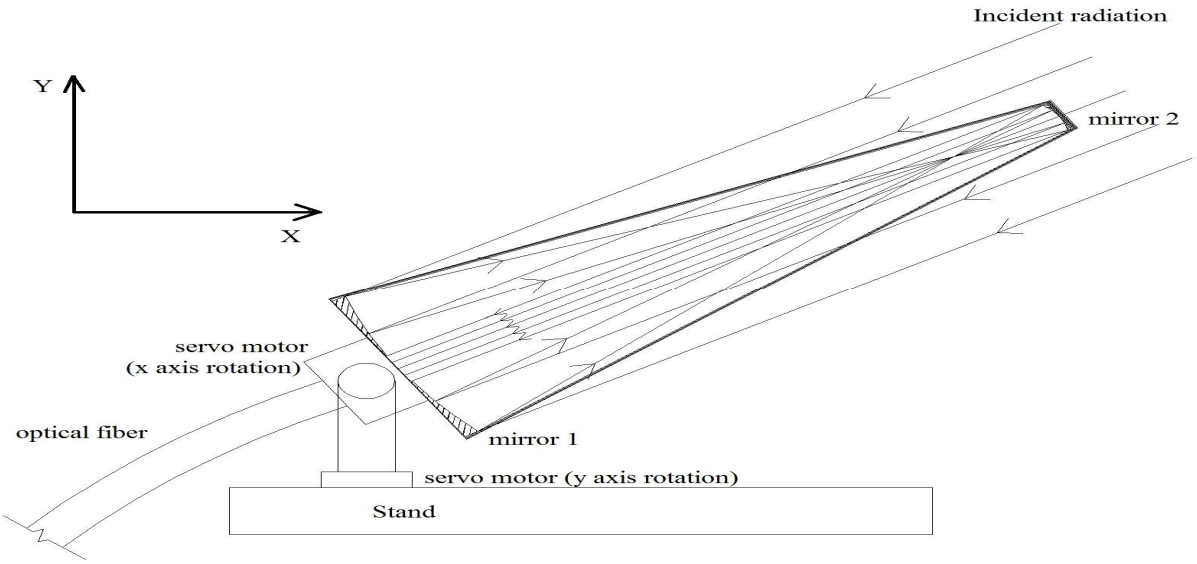

Fig 3 section of the system, parabolic mirrors

III. ADVANTAGES AND DISADVANTAGES

A. Advantages

This system does not pollute the environment. It has one time investment in establishment of the system and it requires a little maintenance. This system does not consume energy from the conventional sources. Its performance is similar to the laser cutting. It does not convert the solar energy into electrical energy so its efficiency is higher than the other solar systems that convert the solar energy into the electrical energy. This system has a solar tracker that tracks the location of the sun to make the system workable all the day.

B. Disadvantages

This system have a big size objective lens to capture the high amount of solar radiation to meet our energy requirements and this system also have a highly sensitive optical arrangements that require skilled worker to set it up at the very first time. Solar tracker consists of some movable parts to move the system with movement of the sun. Installation cost of the system is high. Solar energy received at the earth surface varies seasonally so performance of the system also varies with the solar energy. This system does not work at night because there is no sunlight.

IV. RESULT

A small soldering wire was melted by a convex lens of diameter 50mm and focal length of 100mm. Temperature generated by the system depends on the specific heat of the material, time of the exposer of material in the concentrated solar radiation, mass of the material to be melted and the amount of the radiation incident on the surface of the material. Different types of the material can be welded with this system.

Data for aluminum sheets welded, with different energy incident on work (5310 on receiver) is given below.

Table 1

Power received at receiver (max.) W	Fraction of the power available at work	Power available at work W	Duration of the exposer sec.	Thickness of the Al sheets (can be welded) m	Thickness of Al in mm
5310	1/1	4604.031	0.1	0.000362	3.62
5310	3/4	3453.023	0.1	0.000272	2.72
5310	1/2	2302.015	0.1	0.000181	1.81
5310	1/4	1151.008	0.1	0.000091	0.91
5310	1/5	920.806	0.1	0.000072	0.73
5310	1/6	767.399	0.1	0.000060	0.62
5310	1/7	657.719	0.1	0.000052	0.52

V. CONCLUSION

Different type of the materials can be welded by this system. Temperature generated by this solar beam depends on the mass, specific heat, heat incident and the time of exposer of metal to the beam. This beam is similar to the laser beam (both are light beams). It can be automated like the laser beam welding. All the energy is guided by the optical fibers so it is easy to guide the energy far from the beam generating system. It has zero operating cost, expecting labour cost. It does not require any grid power to weld. It is a clean energy welding process. Cost of the solar beam welding system is 500000rs/KW and cost of the laser beam welding for the same rating is 1820000rs/KW.

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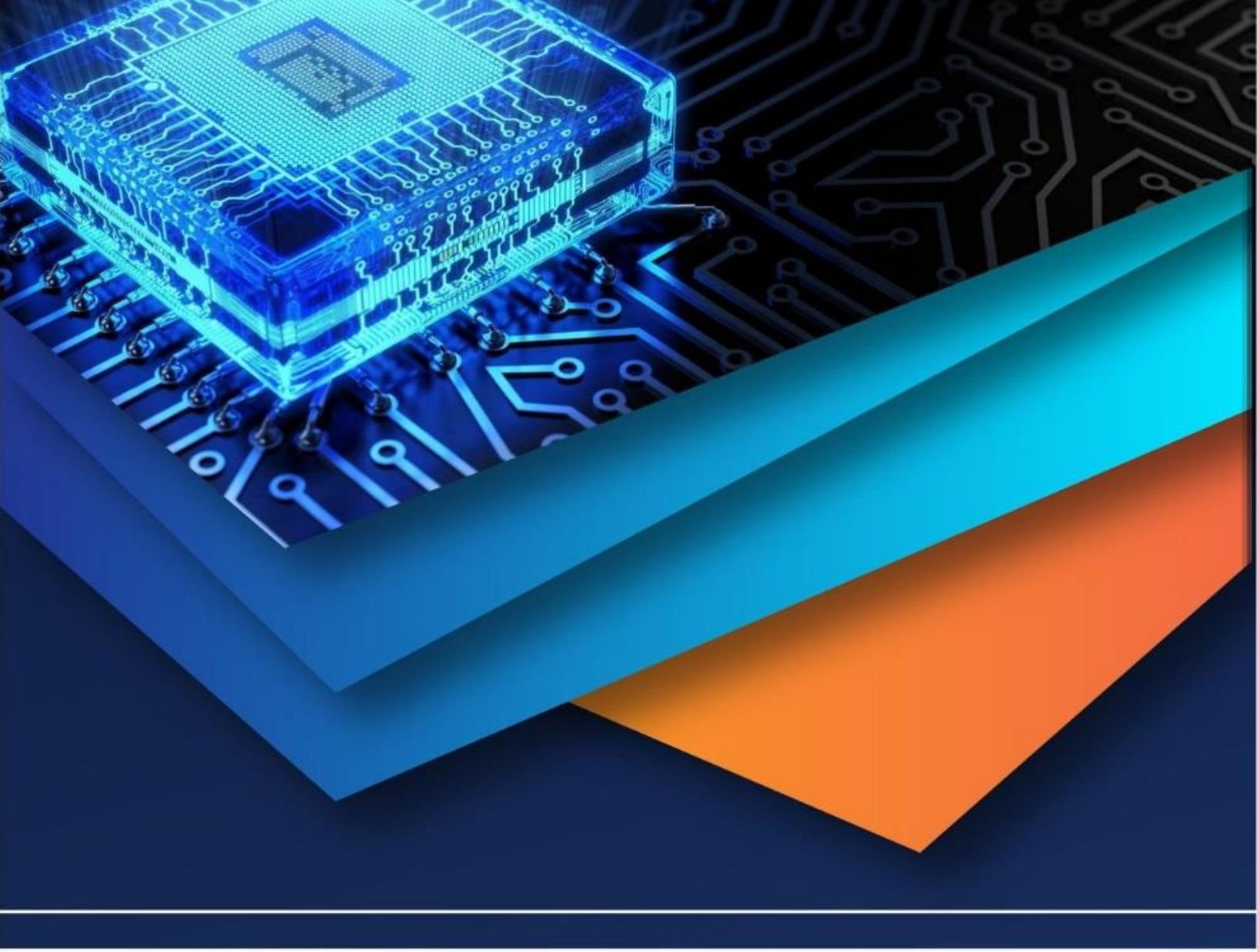

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