Solar Iron Press based on Direct Thermal Heating for Rural Areas- a Step towards Atama Nirbhar Bharat

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ABSTRACT

In the 21st century, with the advancement in technology, the amount of fossil fuel burned has increased rapidly. In India 61% of the grid electricity is produced from coal-based thermal power plants, 9% is produced from natural gases, 2% from nuclear energy, and the remaining 28% is harvested from the renewable source of energy which includes hydropower (15%), solar PV (8%), and wind energy (5%), etc. Constant attempts are being made to shift towards sustainable energy sources from conventional sources of energy. Already many household appliances such as water heaters, pressure cookers, table fans, flashlights, etc; are converted into solar-based appliances. One such appliance which is found in almost every household is the Iron press. There are different categories of iron presses such as electric iron, coal-fired iron, and gas-fired iron, all are dependent upon non-renewable sources of energy. Except for electric iron press, others give rise to carbon emissions in the environment. Also, in India, many such localities exist that lack electricity or non-renewable sources of energy. So, it is now a need to develop a system that would be based upon the renewable source of energy and would provide a solution for ironing the clothes at minimum cost. In this paper, a novel attempt has been made to develop an ironing system based on the concept of direct thermal heating using solar radiation.

Keywords: Solar iron press, Fresnel lens, direct thermal heating, oil heating, hollow oil pocket.

I INTRODUCTION

The iron press has a very important and unavoidable role in today's society. On one side it is used to make the clothes wrinkle-free, on the other, it is used to kill the microorganisms in the clothes. The polymer-based fabrics have long chains of molecules. The chains of molecules get entangled and appear as wrinkles on the fabrics. The wrinkle-free fabrics and clothes look attractive and different designs can be facilitated in wrinkle-free clothes. The iron press is an appliance that is used either at home or in the laundry to make clothes wrinkle-free. In ironing, the hardbound molecular chains are softened using heat and stretched to open up them by the weight of the iron press and the force applied through the handle. On removing the heat and pressure the clothes gain a new desired shape [1-3]. Most of the fabrics can be ironed in a temperature range from 180°C to 220°C [4-8]. The fabric such as cotton requires a high temperature of 200°C [9-12] in ironing to loosen the molecular chains to make it wrinkle-free.

The history of the iron press goes long back to the 15th century. The first even iron press was in the form of a box with a flat bottom. It was fired type iron box, which was heated by burning of coal or any such materials like bricks, and slugs. In continuous development in design and principle of operation, in the 19th-century first electric iron press was developed by Henery W. Seeley in 1882. In this iron press, there was no wire attached to the iron press to heat this but it was heated on a separate stand and then used by the operator. Due to no continuous heating, the iron press cooled down early and again needed the heating on the stand. This intermittent operation made the ironing laboursome and monotonous. In further development, the first iron press with electric wire came in the existence in the year 1903, and in the year 1926 first iron press with the steam facility was introduced. The latent heat of steam was used to remove the hard wrinkles that are difficult to remove simply by heat and pressure [13-15].

In the absence of electricity such as in rural areas of the country, there are three alternatives of an iron press, (1) Ironing using a coal-fired iron press, (2) ironing using gas-fired iron press such as LPG (liquefied petroleum gas) or natural gas-fired iron press and (3) Solar iron press based on DC power supply. In a coal-based iron press, the flaming coal is placed inside the hollow metal box of the iron press and the heat transferred through the conduction mode between coal and the inner layer of the base plate is used for ironing the clothes. In LPG (liquified petroleum gas) or natural gas-based iron press, the gas is burned inside the iron chamber in a very controlled manner and the heat generated by the combustion of the gas is utilized to heat up the base and further to iron the garments. Both coal-based and LPG-based iron press uses a non-renewable source of energy to operate which is not only fatal for the operators but also leaves a carbon footprint in the environment.

In the areas where electricity is still beyond reach, people are abundantly relied upon coal-based and LPG-based iron presses, unaware of the harmful impact intended by the presses onto them and to the environment. This research paper acknowledges an idea and design of a new iron press that will operate without the provision of electricity, coal, or LPG. This project discusses fabricating a new solar-based iron press with a comprehensive heating system based on direct thermal heating. The fact that India, being partly tropical and subtropical, receives sunlight all-round the year supports the idea of this new solar iron press based on direct thermal heating through solar radiation.

II WORKING PRINCIPLE AND DESIGN OF THE PROPOSED SOLAR IRON PRESS

In this work, a solar iron press with direct thermal heating has been designed and developed. The principle of operation of the newly designed solar iron press is based on direct thermal heating. In this principle, a thermal fluid is used to heat the iron press rather than direct current as in traditional solar iron presses. This novel setup based on direct thermal heating emits zero carbon print in the atmosphere.

Figure 1 shows the 3-D model of the complete setup of solar iron press based on direct thermal heating. The setup consists of a Fresnel lens to focus solar energy on the oil tank. A Fresnel lens is a high-power lens that can concentrate a very high level of heat at the focusing point. The Fresnel lens is mounted on a stand that can be moved on the wheel as well as the lens's frame can be adjusted as per the direction of the incident solar rays at a different time of the day.

The Fresnel lens, with its high energy density, may heat the oil in the tank to a temperature of up to 250 degrees Celsius. The oil tank is insulated to prevent heat dissipation from it. The top portion of the lid of the cylinder is open to the focusing light to heat it. The lid of the oil tank is equipped with metallic rods that are immersed in the oil to heat the oil from deep inside. The immersion roads are made of good heat-conducting materials such as copper, aluminium, etc. From the oil tank two flexible hose pipes are connected to transfer the hot oil from the tank to the iron press. One among them is directly connected to the press whereas the other is connected via a hand-operated hydraulic pump. This hand-operated hydraulic pump continuously regulates the flow of the oil from the oil tank to the iron press and vice versa, maintaining the temperature of the oil to press the clothes.

Figure no. 2 shows the 3-D model of the iron press which compromises of a metallic base plate with vanes attached to it in the vertical direction, an oil pocket with fins as guiding plate, two connectors for fixing the hose pipe, a metallic cover with an arrangement of handle for gripping purpose, and a nut and screw assembly at the top of the metallic cover. The oil pocket is designed in such a way that the fins or guiding plate perfectly align with the vane of the metallic base plate. Further, the metallic base plate is heated by the oil pocket through the conduction mode of heat transfer. Nut and screw assembly at the top of the metallic cover has a very significant role as it is used to break the contact between the base plate and the oil pocket, lowering the risk of overheating. The guiding plate of the oil pocket will avoid the rotating phenomenon of the oil pocket when uplifted to break the contact. Usually, a temperature ranging between 200-220°C is required for the ironing of the clothes which can be adjusted by the operator just by rotating the nut and screw assembly.

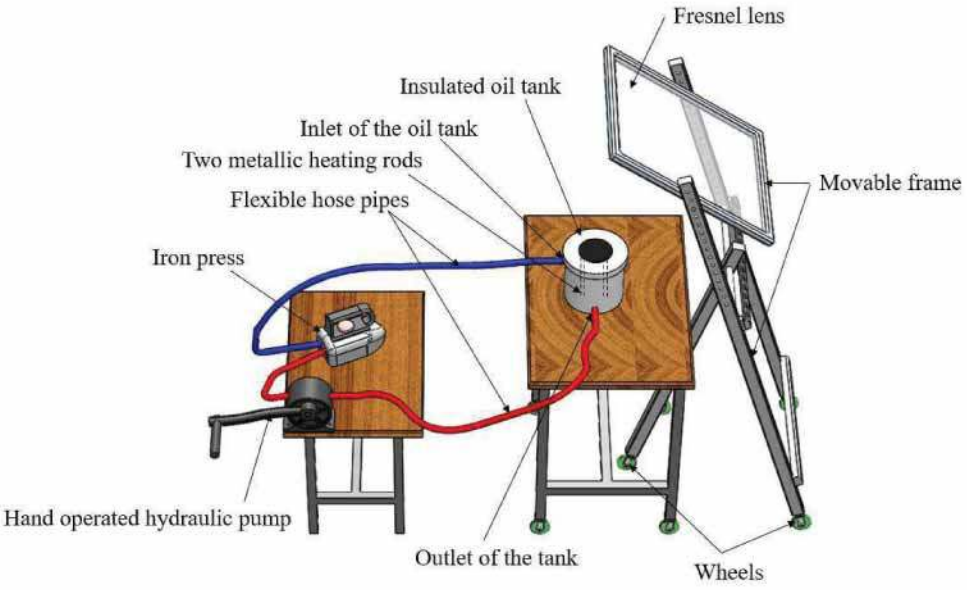

Fig. 1 3D model of solar iron press using direct thermal heating

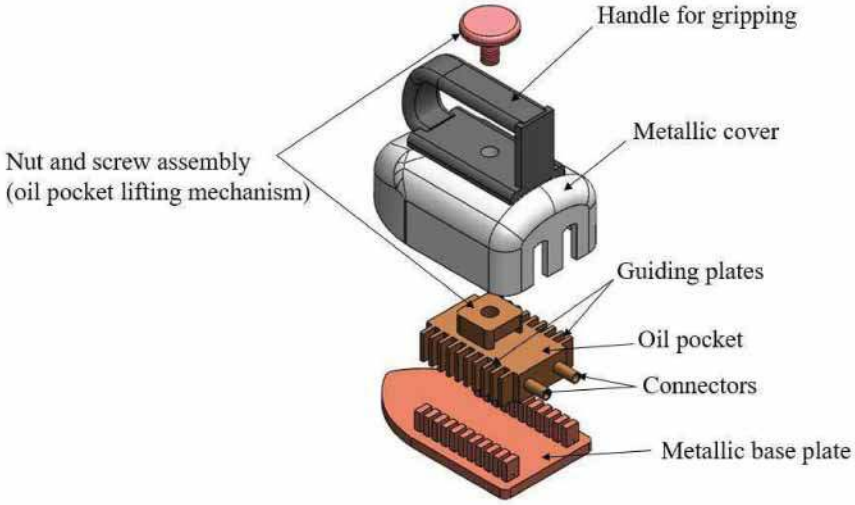

Fig. 2 Solar iron press with oil pocket

III CONCLUSION

The solar iron press is a revolutionary design in the field of ironing clothes in rural as well as urban areas which work on the principle of direct thermal heating. Its handy design makes the solar iron press more convenient. The Fresnel lens mounted on the newly designed solar heating system collects solar radiation emitting from the sun, thus leaving zero carbon print in the environment. The geographic location of India is such that solar radiation can be harvested in almost every part of the country throughout the year, thus making this design feasible. The invention of the solar iron press could be economically advantageous and adaptable for people who are living in rural areas and are unable to access renewable energy sources.

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