# APPLYING NEW METHOD FOR WATER PUMPING BASE ON SOLAR CONCENTRATING TECHNIQUE

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ABSTRACT

Water pumping in many applications is very important. Solar concentrating techniques make an opportunity for Cheaper and more Reliable Pumping water .This paper; propose a new method for water pumping based on solar concentrating technique. This method is more reliable and cheaper in comparison with current solar concentrating techniques like Dish-Stirlling and coupling a steam engine with a solar dish. The main competitive advantage of proposed method is in cases that current methods for pumping water are expensive or impossible to use. For example in long distances that Pumping have troubles like water hammer effect. This system includes three main parts: 1-Solar Collector 2-Compressor apparatus 3-Air Lift Pump. Key innovation in this system is application of a new compressor that directly use heat (that is receive from sun by solar collector)for compressing air, and by means of this design, energy losses and initial and running costs will reduce greatly and efficiency of solar water pumping will increased.

## 1. INTRODUCTION

Solar water pump is a pumping device powered by solar energy, mainly used for agriculture, irrigation, desert control, pasture animal husbandry, city waterscape, seawater desalination, living water supply and so on. Solar energy, need no connection to a power grid. It has automatically operation, maintenance free, Easy to install and move high universality, clean and green, have high economic benefits. Usually for running pumps, from source of energy point of view, we have two main categories: 1-Solar, 2-fossile fuels and electrical energy. Most of current solar water pumps are use PV (Photovoltaic) technology as power source. PV solar pumps are very expensive and have low efficiency. Recently engineers have

been searching for another alternative for PV solar pumps that are more efficient and cheaper than current solar PV pumps. One of these alternatives is solar thermal water pumps.

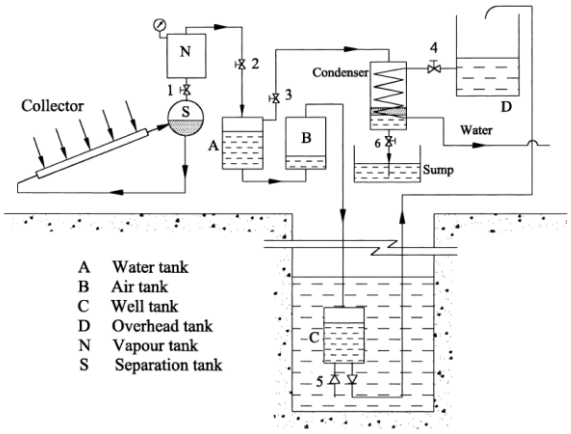


Fig.1: Example Schematic of current solar thermal water pumps. (1)

Fig.1 showed an example schematic of current solar thermal water pumps. Other examples of solar thermal water pumps are Dish-Stirlling and coupling a steam engine with a solar dish. These systems compare with PV solar pumps can reduce costs and increases efficiency, but yet, we could make them cheaper and more reliable and more efficient, which is goal of this paper.

## 2. NEW SOLAR PUMP SETUP

In this paper we introduce new solar thermal water pump. This system (as Shown in Fig. 2) include three main parts: 1-solar collector, 2-compressor apparatus, 3-Air Lift pump

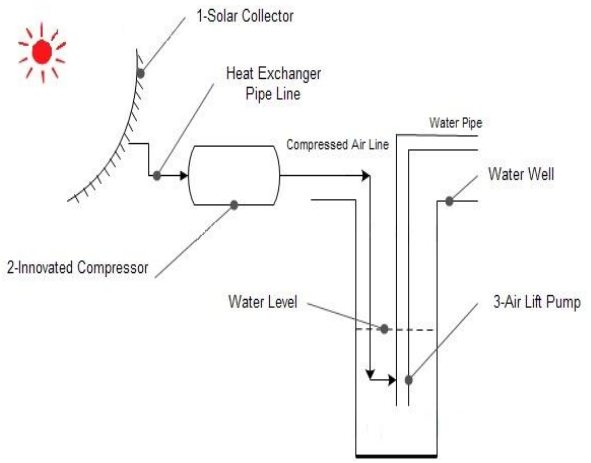


Fig.2: New Solar Thermal Water Pump System (Schematic).

### 2.1 Solar Collector

This system used a Concentrated Solar Collector to heat a heat exchanger fluid (like oil), then this received heat from sun feed an innovated air compressor, which directly use heat to compress air in an Isochoric process.

### 2.2 Compressor Apparatus

To run air lift pump, we need compressed Air. We apply the innovative compressor use heat coming from sun by means of solar collector to increase gas pressure in a closed chamber. A method for compressing a gas by using energy produced from sun. A boiler is provided. The boiler is segregated into an upper chamber and a lower chamber by a barrier such as a piston, a bellows, or a diaphragm. The lower chamber is filled with a liquid having a suitable boiling point and other properties. The upper chamber is filled with a gas to be compressed (here Air). Heat from sun is applied to the liquid in the lower chamber in order to bring the liquid to a boil, and thereby produce pressurized vapor in the lower chamber. The rising pressure in the lower chamber moves the barrier in the direction of the upper chamber, thereby compressing the air in the upper chamber.

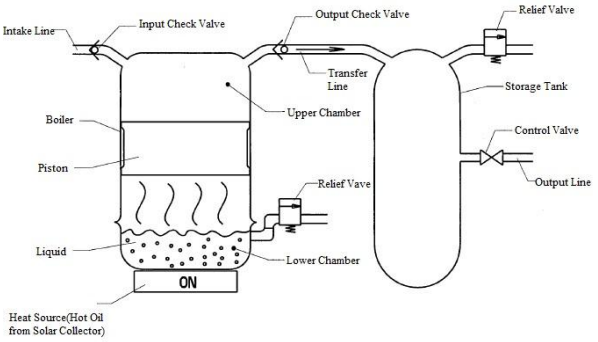


Fig.3: Compressor Apparatus. (2)

Fig.3 is a schematic view of phase change compressor apparatus. Assumed air is an ideal gas here. According to ideal gas law; temperature and pressure are directly related (see equation 1) it means that by increasing air temperature in closed chamber gas pressure will increase.

$PV = nRT = NKT$ (1)

n: number of moles

R: universal gas constant = 8.3145 J/mol.K

N: number of molecules

k = Boltzmann constant = $1.38066 \times 10^{-23}$ J/K

$k = R/N_A$

$N_A$ = Avogadro's number = $6.0221 \times 10^{23}$ /mol

Actually, the design of this compressor is based on an Isochoric process. An isochoric process is exemplified by heating or the cooling the content of sealed; inelastic container. The thermodynamic process is the addition or removal of heat; the isolation of the contents of the container establishes the closed system; and the inability of container to deform imposes the constant-volume condition. (3)

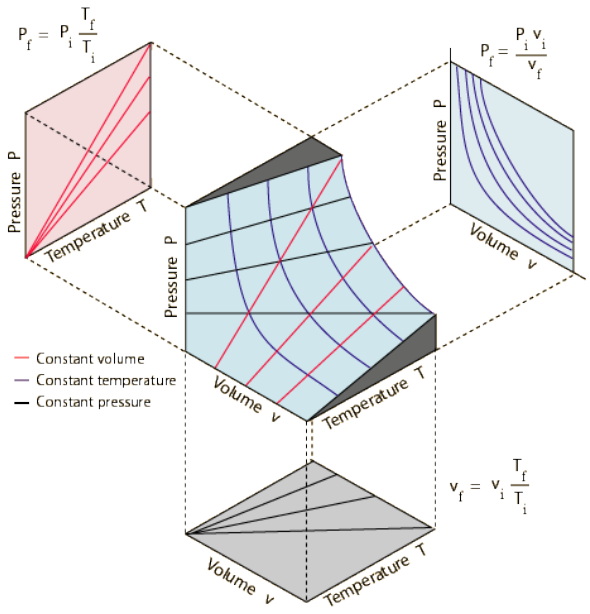


Fig.4: All the possible states of an ideal gas.

This design for air compressor was chosen to reduce greatly energy loses in conventional air compressors and directly uses heat which earn from sun to increase air pressure. This method for compressing air causing reduction of energy conversion times in regular systems for example in the current systems for gain an amount of compressed air at first we convert solar energy into electrical energy and then use this electricity to run an air compressor. But in this proposed method by reduction of energy conversion times, energy loses and initial and operating costs of system will greatly decrease. (2)

2.3 Air Lift Pump

The primary virtue of air lift pumps is that they are extremely simple. A rising main, which is submerged in a well so that more of it is below the water level than above it, has compressed air blown into it at its lowest point (see Fig.5). The compressed air produces a froth of air and water, which has a lower density than water and consequently rises to the surface. The compressed air is usually produced by an engine driven air compressor, but windmill powered air compressors are also used.in this paper we proposed new air compressor as mentioned it in part 2.2 above. The principle of it is that air/water froth, having as little as half the density of water, will rise to a height above the water level in the well approximately equal to the immersed depth of the rising main. The greater the ratio of the submergence of the rising main to the static head, the more froth will be discharged for a given supply of air and hence the more efficient an air lift pump will be. Therefore, when used in a borehole, the borehole needs to be drilled to a depth more than twice the depth of the static water level to allow adequate submergence.

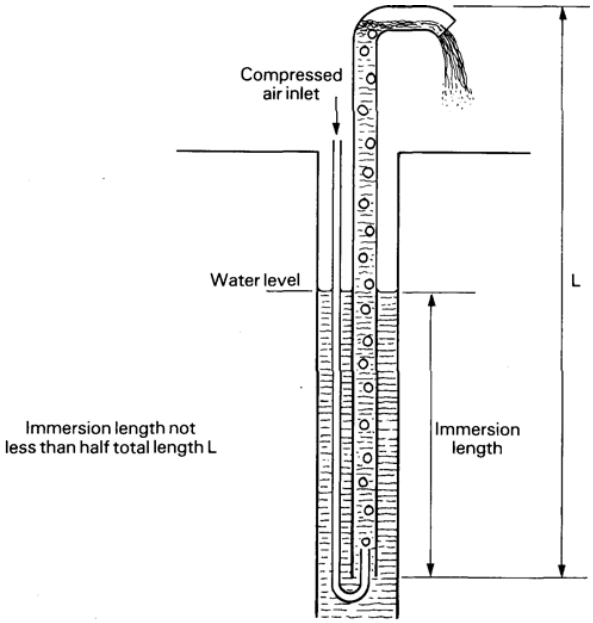


Fig.5: Air Lift Pump (Schematic).

The main advantage of the air lift pump is that there are no mechanical below-ground components, so it is essentially simple and reliable and can easily handle sandy or gritty water. The disadvantages of exciting air lift pumps are rather severe; first, it is inefficient as a pump, probably no better, at best, than 20-30% in terms of compressed air energy to hydraulic output energy, and this is compounded by the fact that air compressors are also generally inefficient. Therefore the running costs of an air lift pump will be very high in energy terms. But in proposed method that is come in this paper we try to overcome efficiency barrier of compressor by innovating in air compressor and design a new model of compressor to generate compressed air by heat that getting from sun, as mentioned in part 2.2 of this paper. Second, disadvantage of air lift pump is that, it usually requires a borehole to be drilled considerably deeper than otherwise would be necessary in order to obtain enough [submergence, and this is generally a costly exercise. This problem is obviously less serious for low head applications where the extra depth [required would be small, or where a borehole needs to be drilled to a considerable depth below the static water level anyway to obtain sufficient inflow of water. (4)

## 3. OTHER POSSIBLE PLAN

The other alternative plan for solar thermal water pump system uses thermal energy of sun to vaporize water and this vapor could raise any water well and have not any moving part. Water that be earned by this manner is pure water. A schematic view of this plan is shown in fig.6.

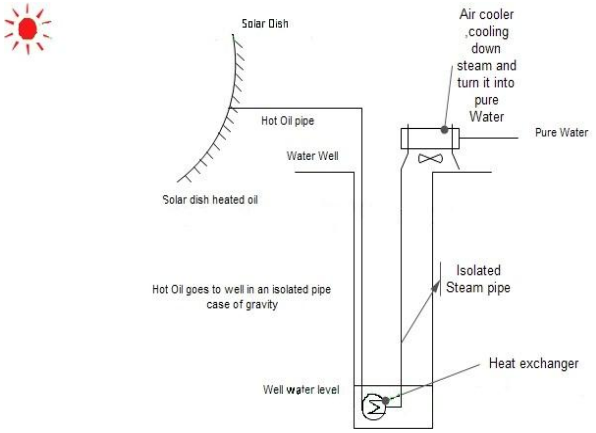


Fig.6: Schematic view of a Solar Water Pump base on Vaporization.

In this proposed method, as you can see in Figure 6, we use a solar concentrating dish for heating a heat exchanger fluid on top of water well and this heated fluid move inside of well pro of gravity, by using a heat exchanger hot heat exchanger fluid, heated water inside of well and vaporized water. This vapor steers into isolated pipe and vapor rise up on top of well and there, vapor turn into water with a condenser and will be ready for use. This method can be used for water and waste water purification and desalting, and pumping water together for agricultural or other uses. Like any other engineering system this one have advantages and weaknesses but it will be the best choice of some special applications like pumping salty or dirty waters.

## 4. CONCLUSION

In This Paper, we introduce two new solar thermal water pump systems. Solar energy operated water pumps had attracted considerable attention of engineers, solar technologists and manufacturers since the beginning of twentieth century. Small sized solar water pumps are potentially suited to the needs of millions of small farmers in developing countries. These unconventional pumps can be used particularly in rural areas, which are not electrified for irrigation purposes. In addition methods that are introduced in this study have capability to use as new concepts for solar energy storage in future. (5)

5. ACKNOWLEDGMENTS

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