How the solar concentrator works with a fixed focus and how it is made?

Introduction: Basically, any system that can collect solar energy in a specific area is called a solar concentrator there are different types of solar concentrators that are as follows:

1: Parabolic solar dish

2: parabolic trough

3: Concentrating Receiver Systems

Basically their functions are based on reflection and whatever the quality of the reflectors used better, the focus of the system is higher. Each of the existing solar concentrators has its own mode of operation, but the most important factor in a good concentrator is that it can provide solar energy with the lowest cost and highest efficiency for us. The most important expectation of solar concentrator system is converting solar energy into electrical energy. Of course, we have not been very successful in this way, because the cost of converting the focal heat of these concentrators to electrical energy is not very affordable.

The heat focus is fixed, in the two systems of parabolic trough and concentrating receiver. But in, the parabolic solar dish, focus is not fixed and moves with the dish.

We will now briefly discuss the disadvantages of each system separately.

1. Everything looks good in concentrating Receiver systems but the big problem is the complexity of the system, the expensive system and the need for large space. Therefore, the above system cannot be used in poor countries and home use of this system is also rejected.

2. The focus is tubular and linear and fixed, in the parabolic dish system, But because the reflectors move in this uniaxial system, so the loss of solar

energy in this system is significant and is more suitable for the tropics. Also, the focal heat in this system is less than the other two systems, why?

3. In the parabolic solar dish system, the concentration of solar energy in Its focus is acceptable, and it can be used on any scale, the only objection is that their focus is not fixed and this objection creates many problems that are as follows:

A) If we use a heavy focus in this system, like: sterling motor or similar cases, the whole system will be heavy, and equipment to balance the system will be more expensive.

B) The entry and exit of very hot fluid, from the focus of this system in power plants to reservoirs such a boilers will be problematic due to the movement of the focus.

C) Because the purpose is to use and access the focal heat of the dish, so in this system it is not possible to use a large focal length this means that very large and economical dishes cannot be used.

Now we want to use a system that has all the benefits of a parabolic solar dish but its focus is fixed and it does not have the problems of parabolic dish.This system called solar concentrated invention in fixed focus. In this article, we will discuss the principles of its work and make a simple example of it.

To begin with, we raise a problem and analyze the answer.

Problem: Design a system with a concave mirror that its focus is a fixed point and the mirror can rotate 363 degrees horizontally and 90 degrees vertically.

To solve the above problem, we first assume that the concave mirror, or dish, is a separate part of a geometric sphere whose center is O and its focus is F, as in Figure 1

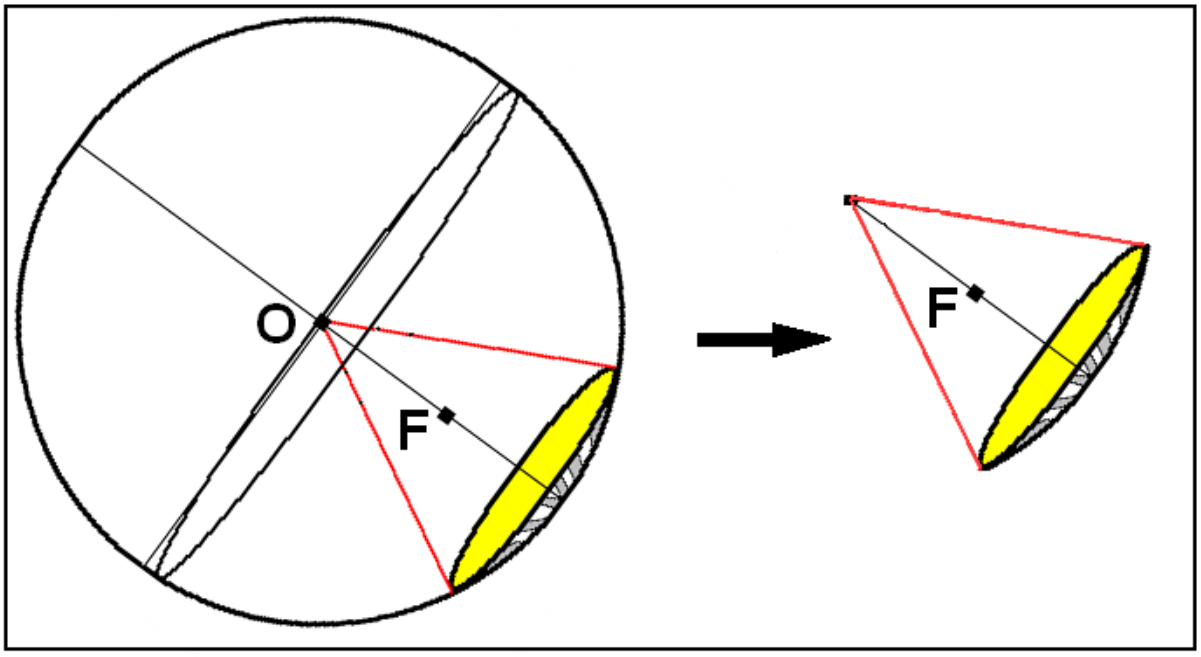


Figure 1

Assume that the detached dish has a reflector and we put it in front of the sun In this case, the dish must make two horizontal and vertical movements throughout the year and anywhere on the planet to be able to concentrate sunlight in its focus. The maximum angle of motion horizontal dish 183 degrees and maximum vertical angle of the dish is 90mdegrees at the best situation on a full sunny day when the sun has the most radiation (equator) And this angle will be less in other parts of the sphere of the land. The range of motion of the dish has now been determined at figure 2. If you look at sphere of dish in figure 1 in way of two dimensions we will see it as a circle and the radius R corresponds to the large circle and the ra Corresponds to the focal circle F.

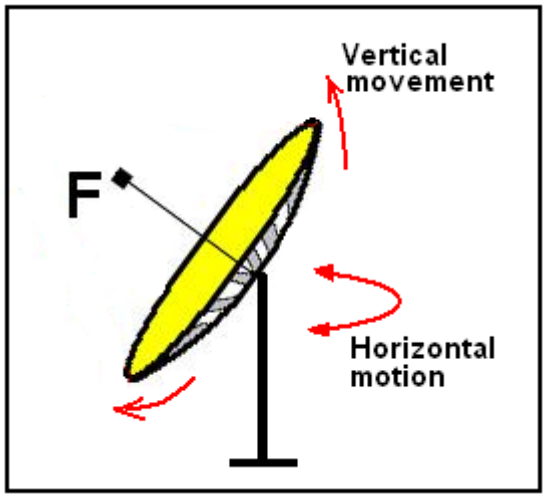


figure 2

So in Figure 3 the focal circle that has the

radius r with the main circle of dish is tangent at point m. In this case, the center of the main circle is on the focal circle (point O).

Now if a circle with radius R is drawn on any point of the focal circle, this circle will be tangent to the focal circle at one point, this issue is quite clear in Figure 4.

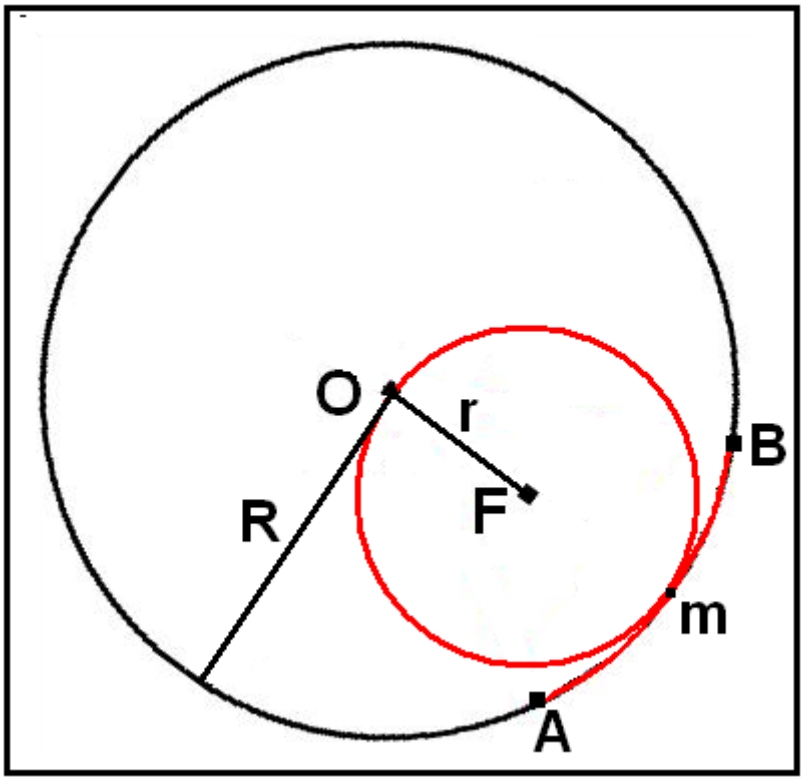


Figure 3

Therefore it is quite clear that if the concave mirror AB in Figure 3

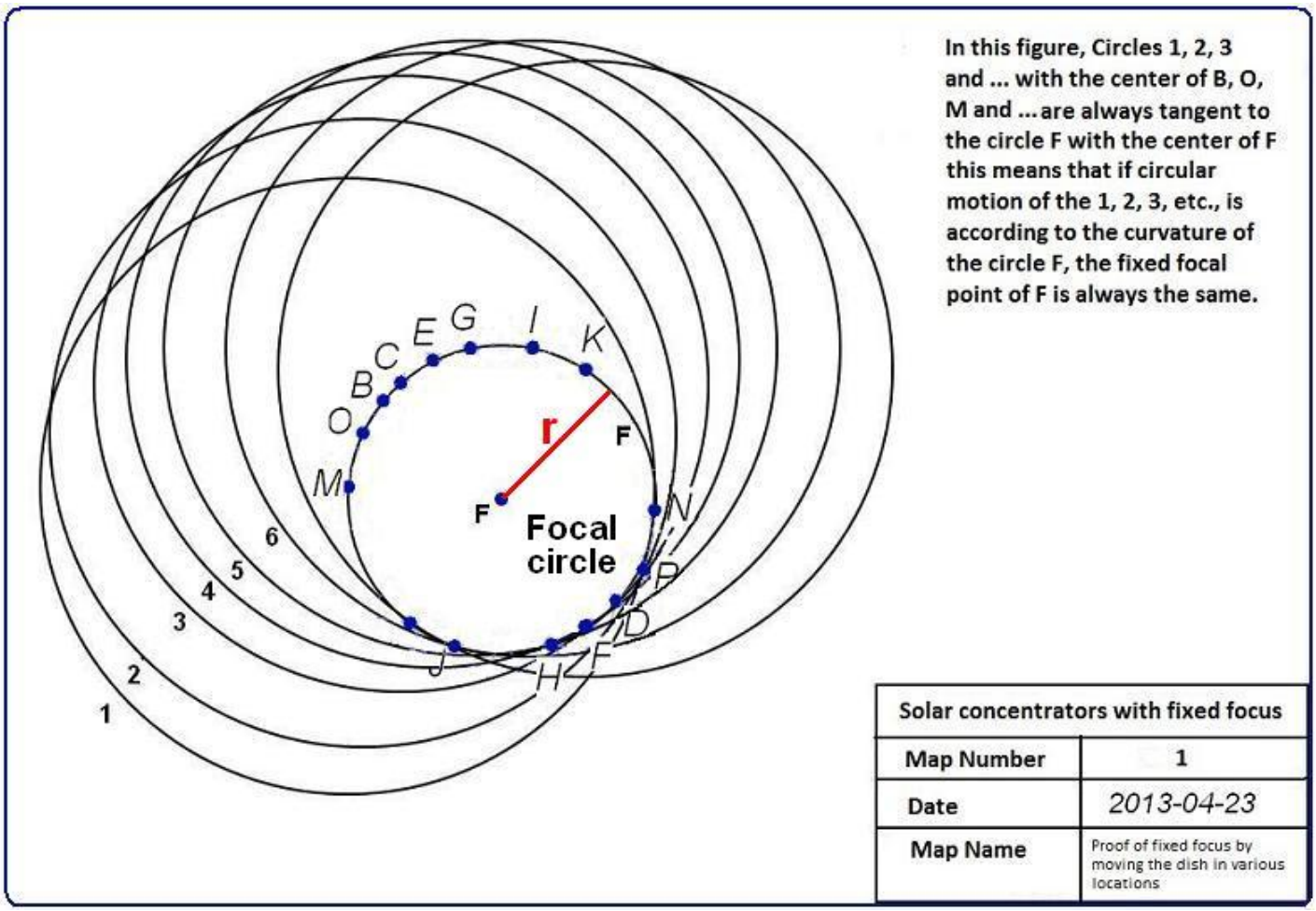


Figure 4

Corresponds to the radius r and move on the main circle, its center will always be point F.

In fact, the circle of the dish changes with its movement from moment to moment and of course its center also moves from moment to moment, but its focus remains constant. So it is obvious that we had to move the center of dish tangentially to the focal circle. Figure 5 shows the steps of moving the AB dish according to the focal circle.

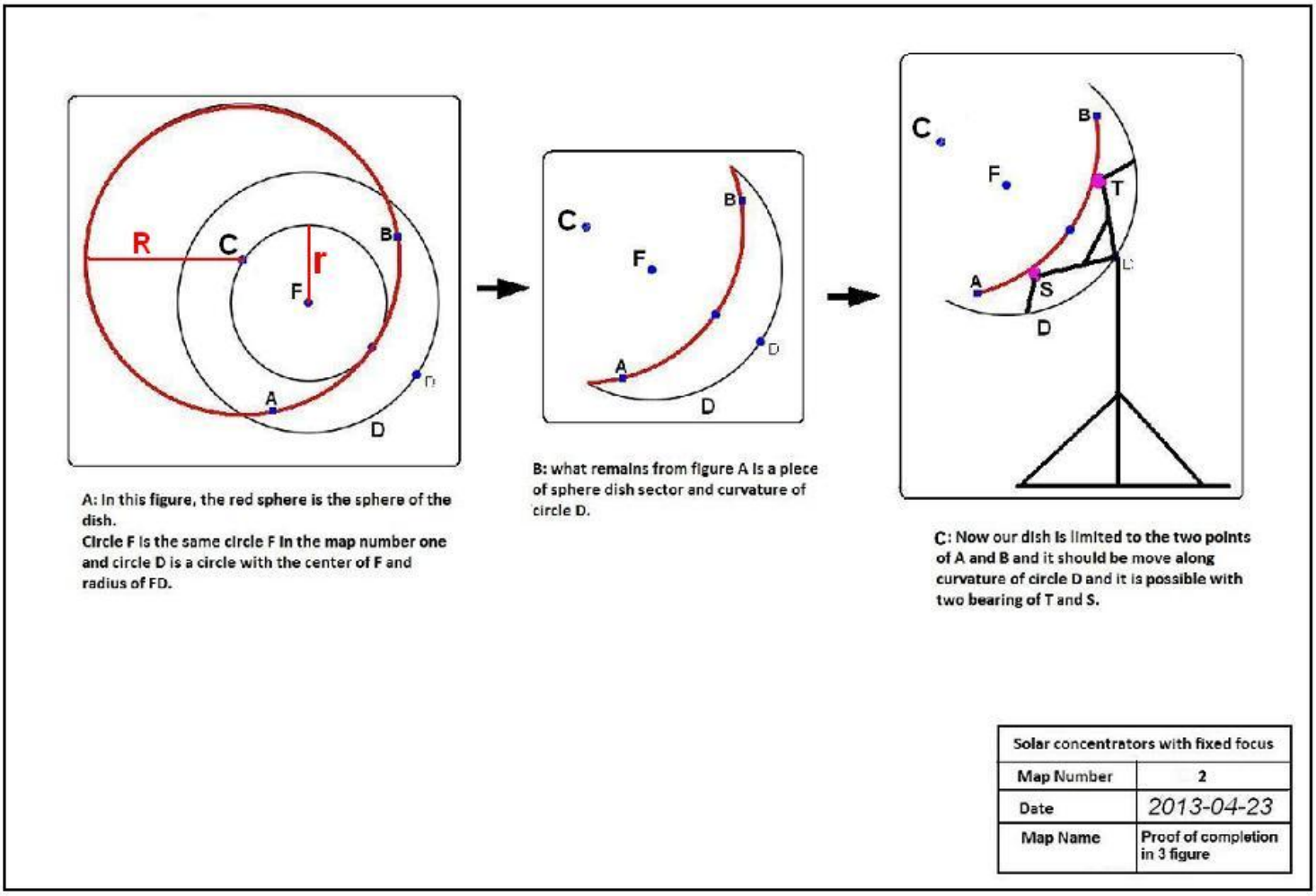
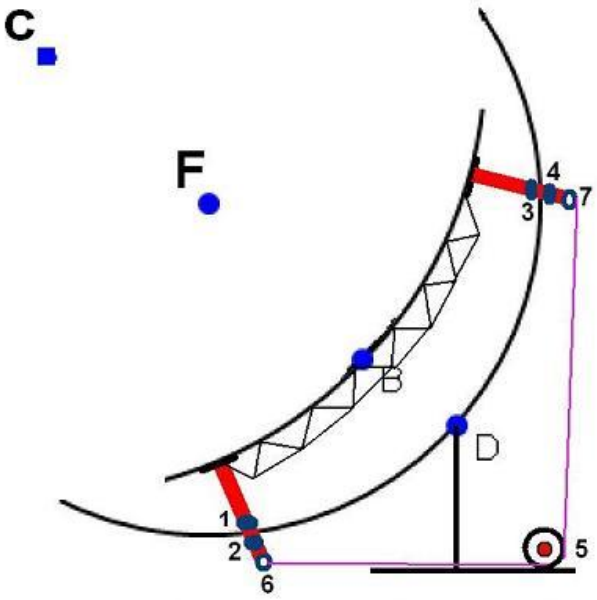


Figure 5

In this figure, the circle D to the center F is considered as the support for the movement of the dish. And a rail connection must be provided between the support of the circle D and the circle of the dish for easy movement of the dish. Figure 6 shows a type of dish connection method by using a metal

strap which is part of the same circle D. In this method up and down movement or the same vertical movement of the dish is done by tow wire and of course better solutions can be designed to move the dish.



In this figure, four bearing 1, 2, 3 and 4 have been fixed by a strap to the dish.
On the other hand, on both sides of rails curvatureof D it has mobility.
Now on top of each straps that are mounted on bearings, two holes 6 and 7 is linked with a wire rope to the spool 5 (a round, wrapped around a spool) now with left and right motion of spool 5 dish can be moved vertically and along with D curve.

Solar concentrators with fixed focus	
Map Number	3
Date	2013-04-23
Map Name	Solutions for vertical movement

Figure 6

The larger dish causes that the D-circle has more radius. Well, so far the vertical movement of the dish has been determined. Now we want to consider horizontal movement. For horizontal movement, it is enough to move the dish to the center of focus F according to the circular circumference, and it will be much easier than the vertical movement of the dish.

If we look at the focal system from above, the horizontal motion of the dish will be as in Figure 7. In this figure, a metal ring (green circle) is used as a

support for the AB dish and three bearings make it easy to rotate the dish around the hypothetical circle of the focus and the support ring. I hope you have understood the content well so far, now let's go to how to build,

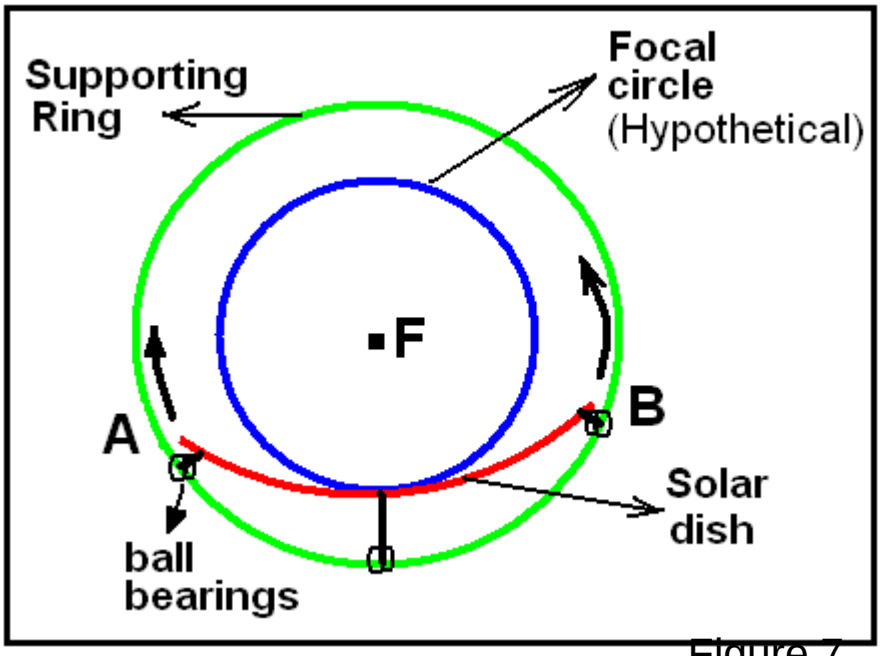


Figure 7

Before making the construction, let us consider a point, suppose we have built a concentrator with a fixed focus. What are available methods for system to access fixed focus in your opinion?

The answer is simple, there are two ways in fact there are two ways to access a fixed focus: 1-far method 2 -near method

These two methods are shown in Figure 8, and it is quite clear that when the focus is fixed and independent of movement of dish, the focus can be placed in two ways like: Figure 8.

If we use first method, it has one positive advantage and several negative advantages. The positive advantage is that the base does not touch the dish and does not need to cut the dish .Its disadvantages are the problematic balance for large dishes and the far distance from the focus to carry hot liquid. And if we use the second method, the balance of the focus is good, but the dish must be cut in a certain direction. We use the second method here to build the system. In the method of construction different ideas can be used but I have tried to use the simplest way to make a small

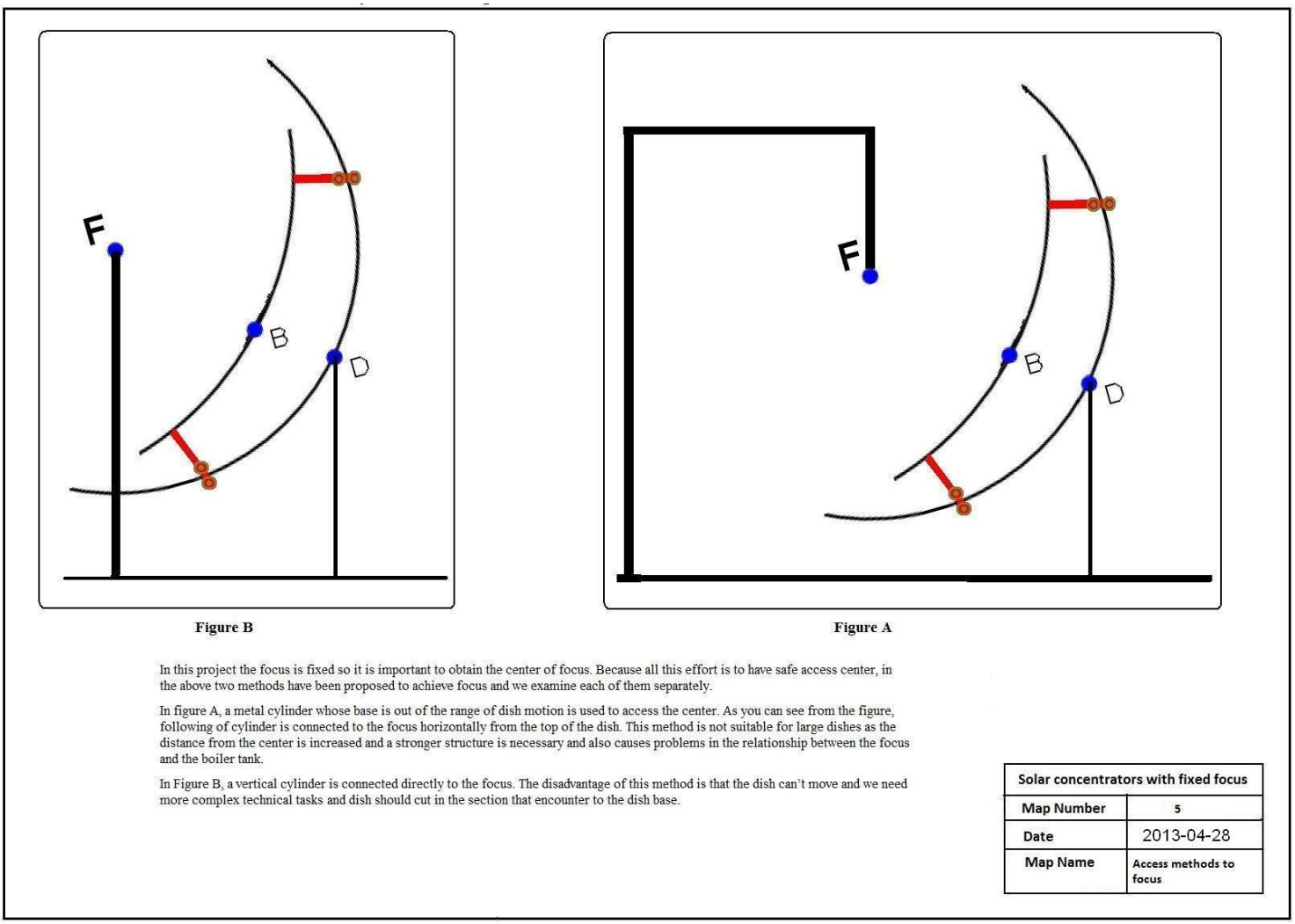


Figure 8

concentrator and explain the steps of making it very briefly and usefully with an image. First, we divide the construction steps.

1-**Construction of base**:

If you pay attention to Figure 7, first we want to make a horizontal support circle (the same as the green circle). in Figure 9, we have made a pipe with a diameter of 2 m (by using bending machines) which must be quite accurate And to install the base of the center as well as the strength of its two vertical diameters, we welded it together, in the middle and center of it, we weld vertically the base with a pipe with a larger diameter as the base of the focus.

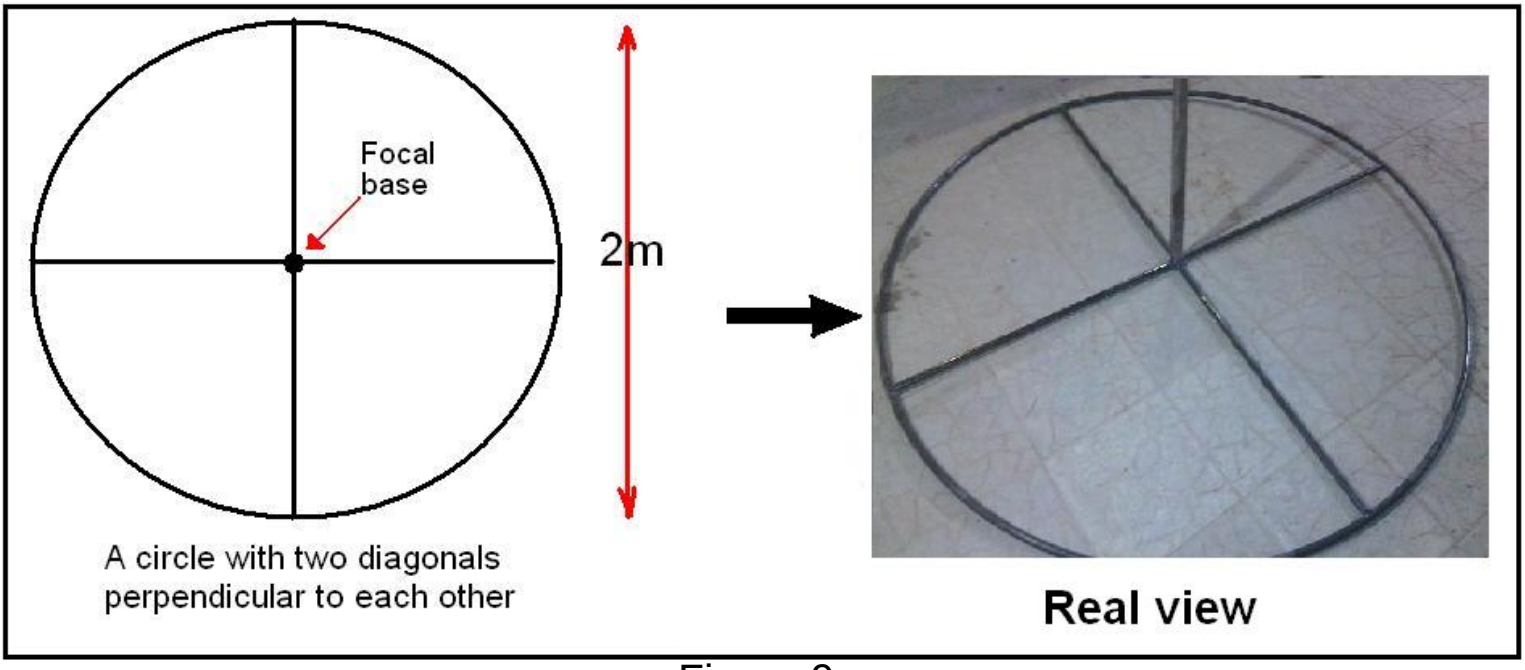


Figure 9

And to install the base of the center as well as the strength of its two vertical diameters, we welded it together, in the middle and center of it, we weld vertically the base with a pipe with a larger diameter as the base of the focus. Now we make another circle in the same way and weld it at a distance of 43 cm with several 43 cm connections. With the difference that two diameters place it 5 cm below the circle, and on the bases and the reason is that we do not want to hinder the movement of the rollers. So first we weld the second metal circle with 43 cm connections to the first metal circle. Then we weld its diameters to the bases at a distance of 5 cm from the second circular ring, this is specified in Figures 10 and 11.

In the meantime, the base of the focus is welded between the welded diameters. Now, the work of the base is finished and we call it rust-proof.

2- **Construction of dish**:

You can use different methods to make a dish, but here used dish of satellite which part of it must be cut and this part is the same place that the base of dish hits to it. (Figure 12)

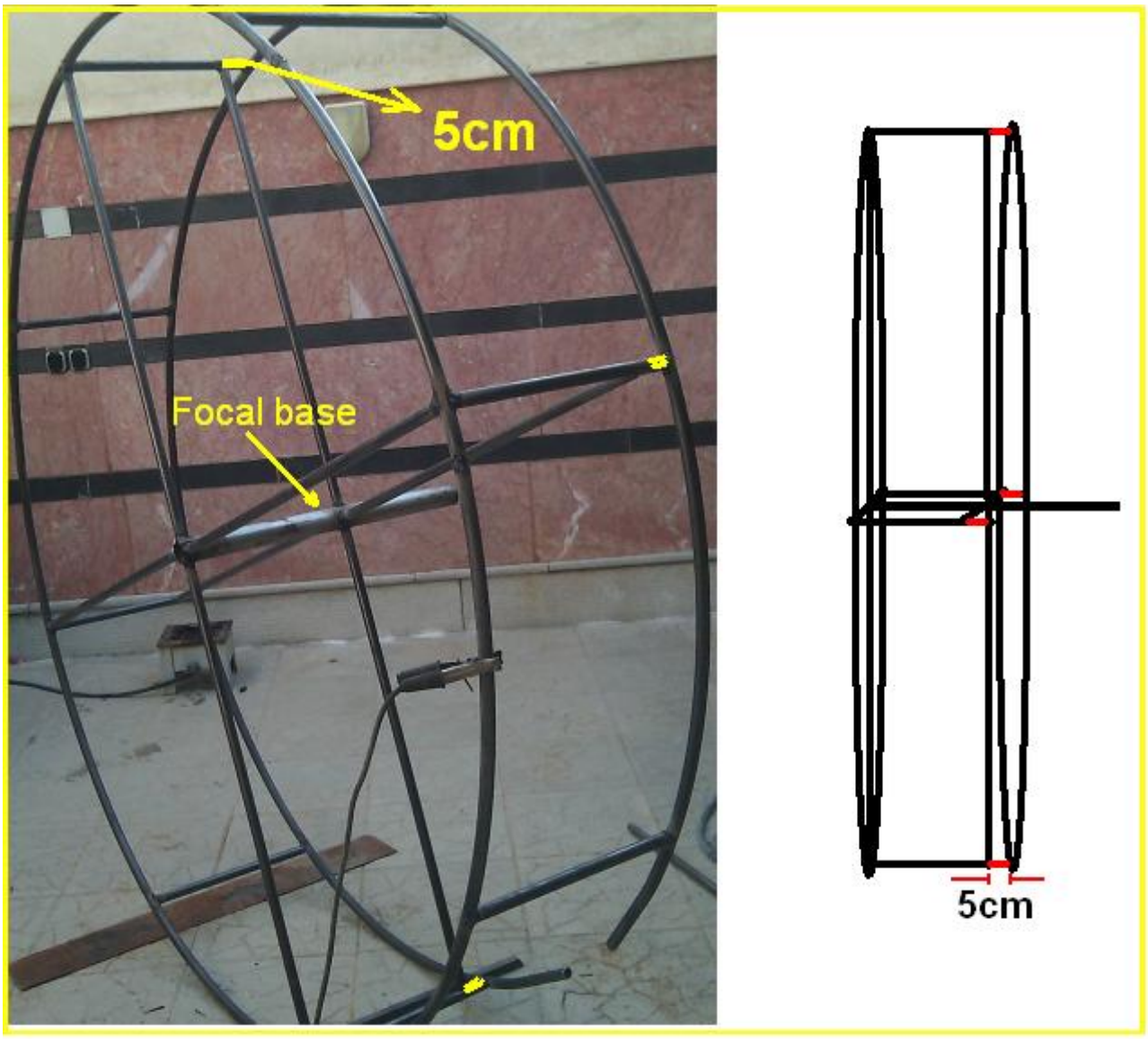


Figure 10

Figure 11

Figure 12

Now, after cutting the dish, we have to make a protector for the dish because the dish sheet is thin and is not strong enough, To do this, we put a suitable structure behind the dish and screw it to the dish .Then we glue the surface of the dish with small pieces of mirrors with a thickness of 2 mm and a size of 5 * 3 cm and with glass glue. (Figure 13)

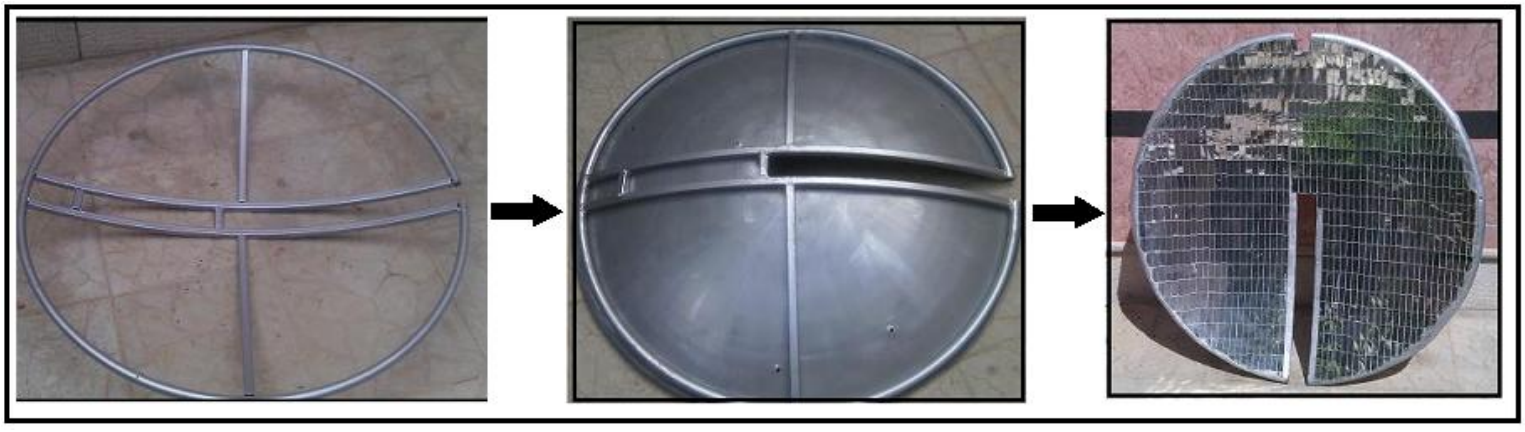


Figure 13

Note: It is better to glue the parts of mirror at the end of building the system

the dish is done and we consider to the moving part of the system:

3- Movable components of dish:

Now we are going to prepare the components that can fit the dish in any position. First, we select a large bearing with a suitable opening so that it can be placed in the base tube of the focus and cover the outside of the bearing with a piece of pipe. Now weld two metal cans (1.8m) to the bearing cover on both sides and connect the ends of the two cans so that on one side there is a DC gearbox motor with a rubber roller and on the other side there is a grooved roller. Now we weld both sides of two pieces of metal cans again in the shape of a triangle and attach the vertex of the triangle to a grooved roller so that the roller rests on the circular tube. (See Figure 14).

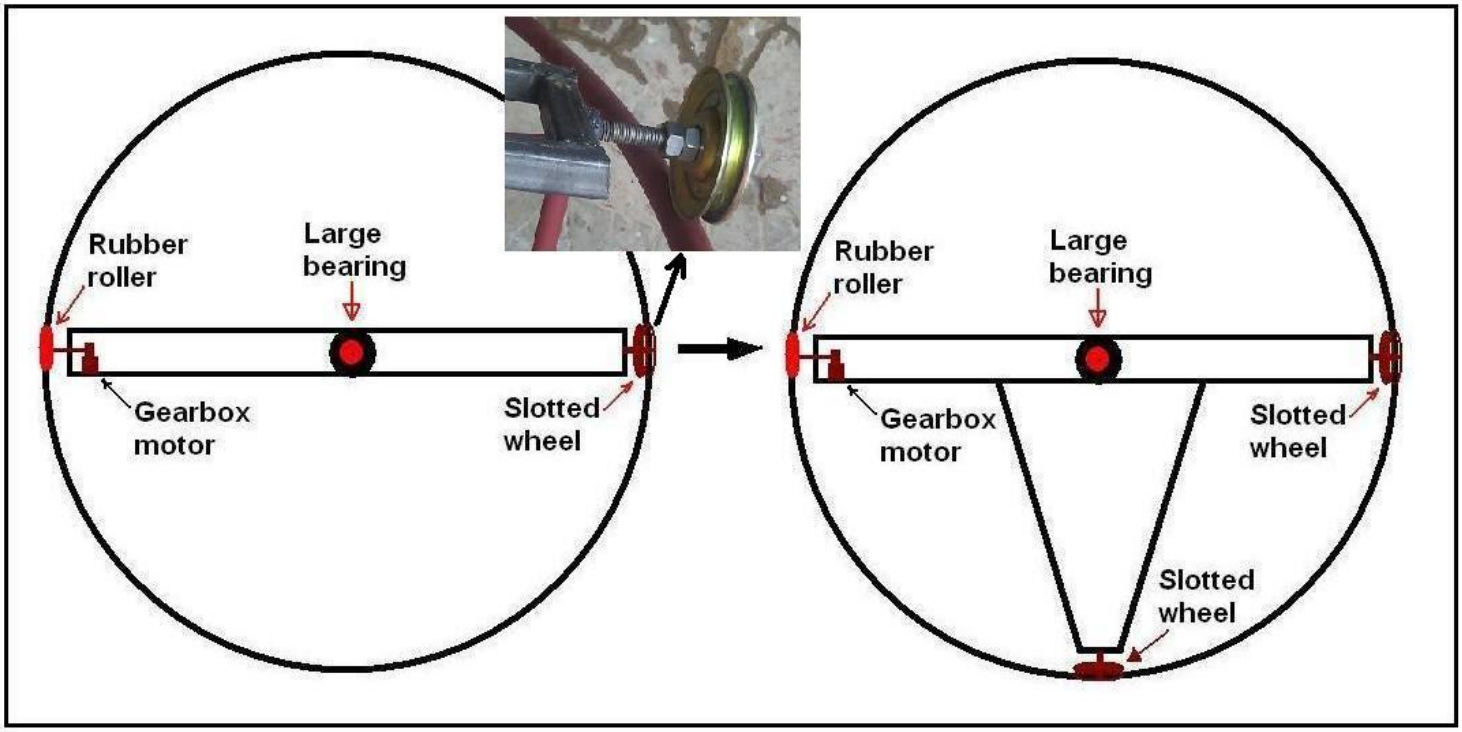


Figure 14

After this, two vertical bases which is proportional to the diameter of thedish should be installed on both sides of the moving part for the dish holder These two bases should be welded and strengthened with two bases as a support.(figure 15)

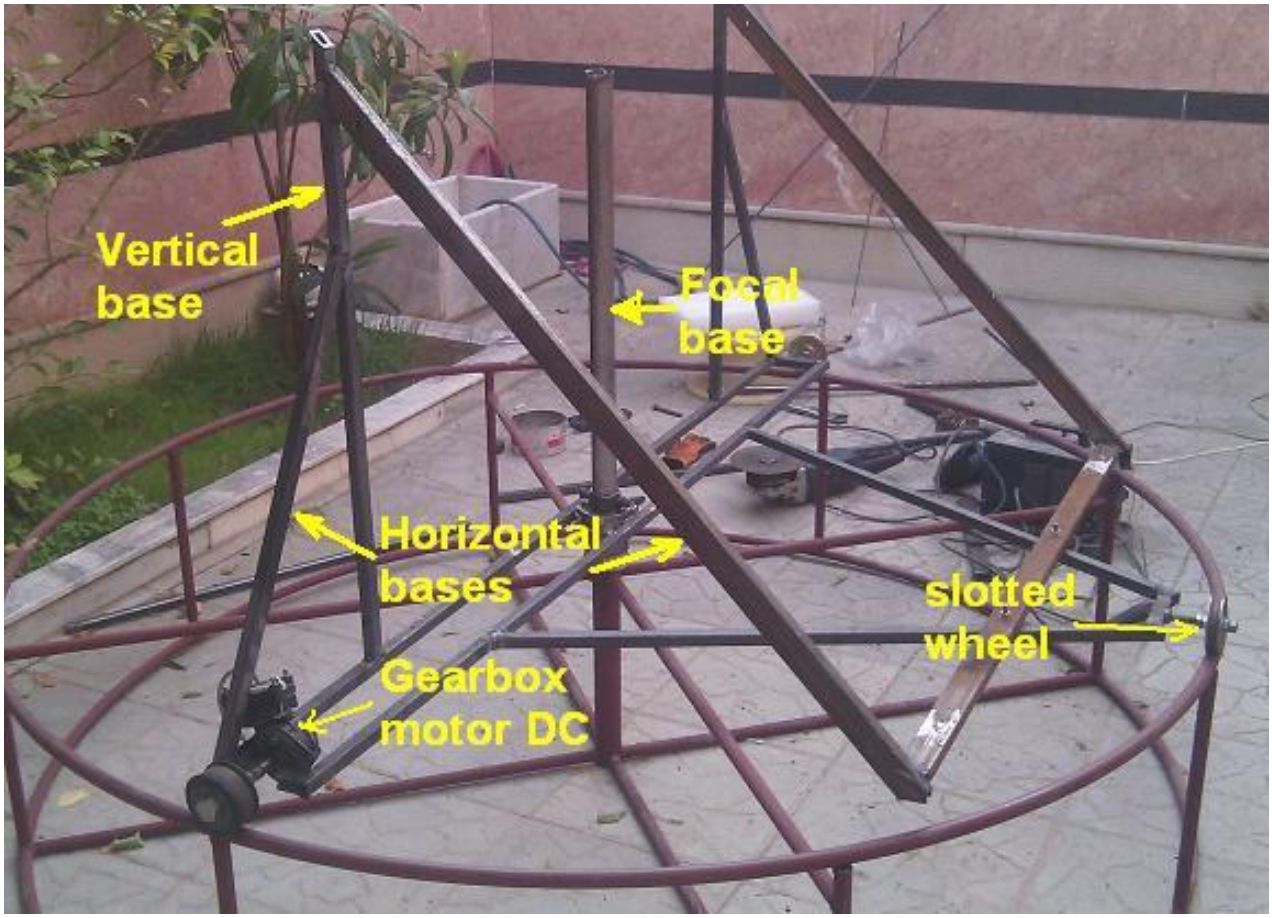


figure 15

Now we pierce the top two sides of the holder and put two screws of suitable size and diameter, then we weld two 73 cm long screws, which one end of it used on screw nut, on the top of the holder. After this, we connect two straps on both sides of the dish to the metal shield and drill them with a suitable diameter of the meter screw and pass the meter screws through the two holes of the belt, and it can be tightened with a nut at the top and bottom of the belt. Now attach the meter screws, which the other end is nut, to the retaining screw. (figure16)

By adjusting the nuts related to the dish, the dish can be placed tangential to the focal circle, in which case the tip of the tube holds the focus.

To make the dish more resistant to wind, a bent rail is placed behind it (the same Circle D is used in Figure 6) and an interface is placed between the

dish and the rail and bearings are used inside the rail.

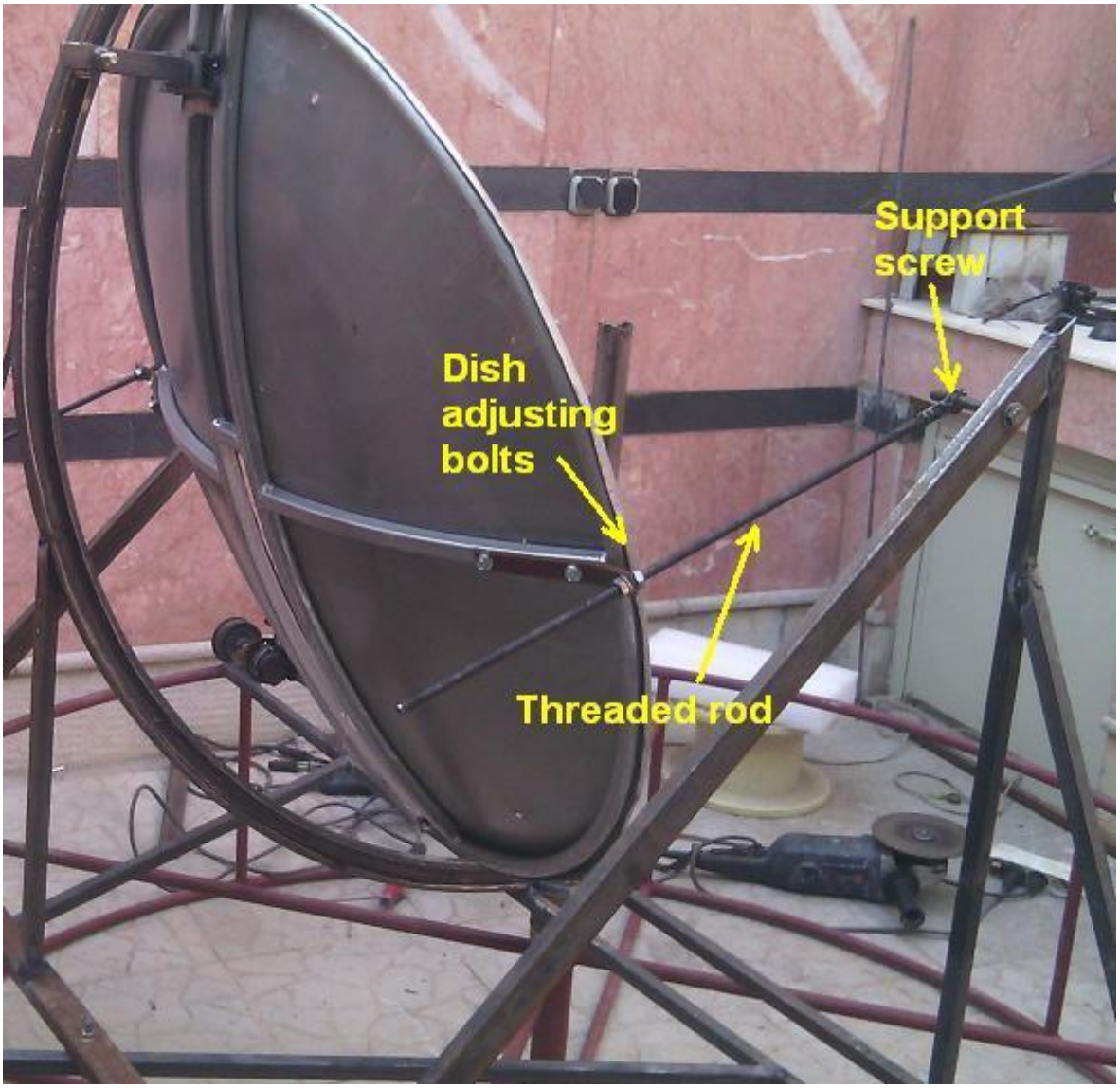


figure16

To move the dish vertically, we use a metal pulley that moves with a DC gear motor and is at the bottom of the movable surface.we place two pulleys at the top and bottom of rail D. We pass a thin tow wire (proportional to the weight of the dish) from the top and bottom of the pulley and wrap it around the metal pulley and tie its two free ends at the behind the structure of the dish. Now if the engine is turned on, raise the dish in one direction and Brings down in the opposite direction. (figure17)

So when the horizontal DC motor is turned on, all the movable parts move and move the dish left or right, and when the vertical DC motor is turned on, only the dish goes up or down vertically. Now the small sample of construction of solar concentrator with a fixed focus is finished and a series of electrical equipment (which will not be discussed in this article) are needed to activate it, including a solar tracker, rechargeable battery, solar panel, electronic circuit and cabling. The focal part can be used in different ways and the focal base tube can be used as a return of hot oil. Figure 18 shows above completed system More appropriate designs can be done for very large systems and this depends on the creativity of the designer. This system can be used in most parts of the world, just it is enough for the sun to appear. Home items that can easily use the above system are:

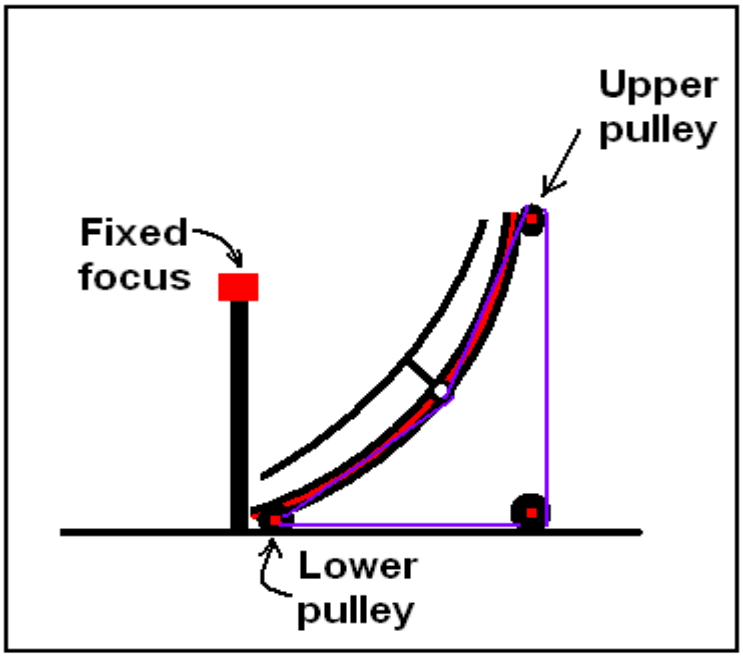


figure17

1- Solar water heater with very hot water

2- Purification of drinking water

3- Internal heating of the house

4- Stove in the kitchen

5- Heating the pool water

Figure 18

And in industrial cases it can be used as a solar farm and sea water purifier. Of course this system is new in solar industry and it has not reached the implementation stage yet. I hope the contents of this section are understandable and useful to you, in fact the solar concentrator system with a focus is an invention and is registered and has an international classification, and any use of the contents of this article is unrestricted by mentioning the source of the article.

Good luck

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