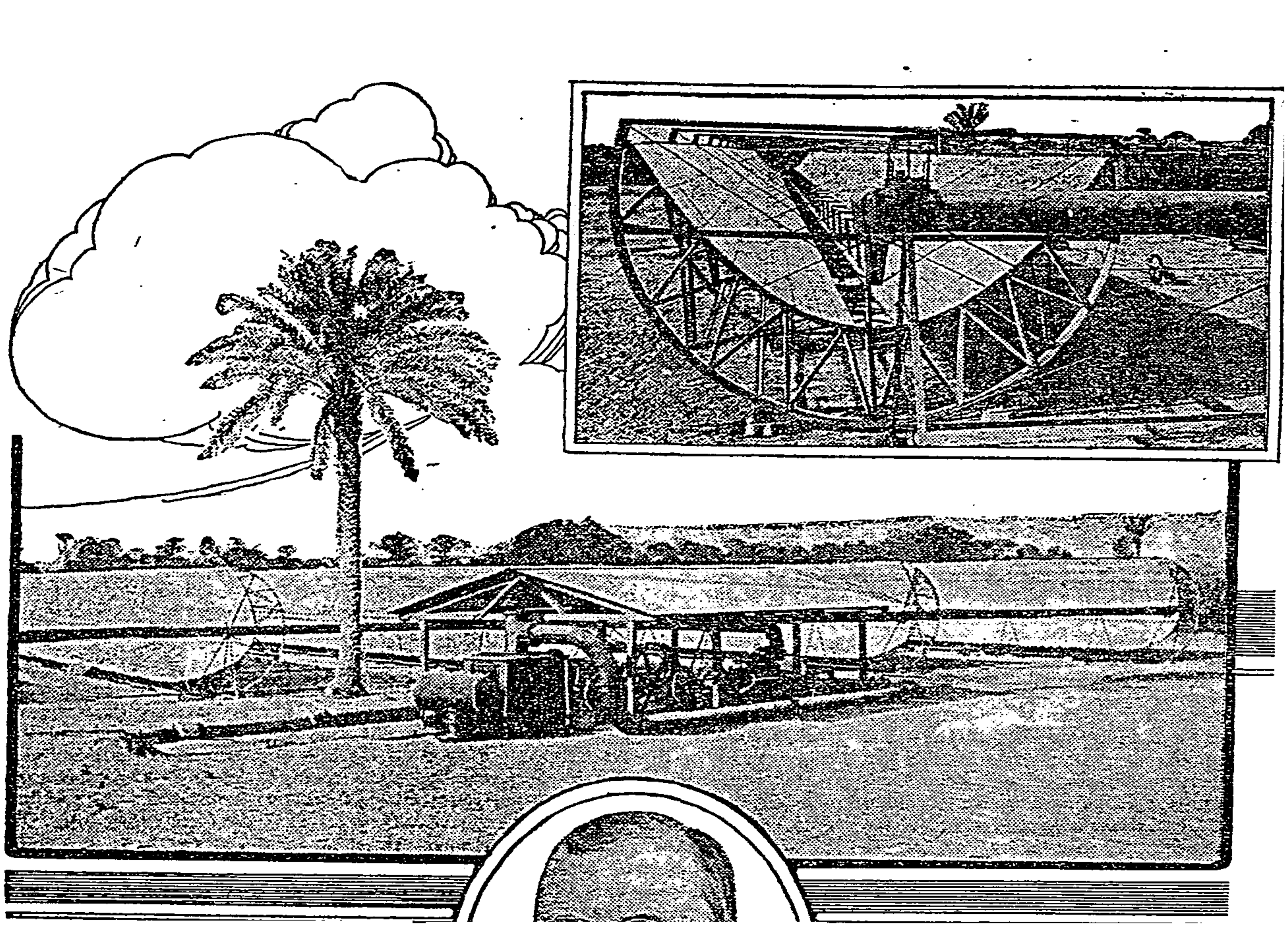
American Inventor Uses Egypt's Sun for Power

Appliance Concentrates the Heat Rays and Produces Steam, Which Can Be Used to Drive Irrigation Pumps in Hot Climates



Egyptian sun power plant

(Top Insert) End View of one of the five heat absorbers

Frank Shuman

THERE is nothing in the tropics cheaper and more plentiful than sunlight; there is nothing in the tropics much scarcer or more expensive than coal. Results from agriculture depend in most of the tropical lands upon irrigation, which means steam if an adequate system is to be undertaken. Scientists have known for many years that mechanical power to any desired amount can be obtained from the rays of the sun, and have measured this power accurately, but owing to its diffuse nature its collection for practical purposes has presented many difficulties.

Some ten years ago Frank Shuman, inventor and scientist of Philadelphia, attacked this problem seriously with an organized force, and there is now in operation at Cairo, Egypt, a plant capable of pumping 6,000 gallons of water a minute, according to a statement made by Mr. Shuman to the writer the other day, which derives its power entirely from the sun's rays concentrating upon boilers, in which steam is produced.

"Just before the beginning of the war," said the inventor, "we had concluded arrangements with the English Government and the German Government to take up the sun power proposition in the tropics, and both sent engineers to test our plant, which has been in operation for two years at Cairo, Egypt. The German Reichstag held a special session to hear what I had to say about sun power, and an audience was appointed for me with the Emperor, but the war began before this could take place. After my lecture in the Reichstag a committee agreed to advance 200,000 marks for a plant in German East Africa. The sun power proposition was also taken up largely in Chile, but the war began and everything of this kind has been laid on the shelf.

"We have proved the commercial profit of sun power in the tropics and have more particularly proved that after our stores of oil and coal are exhausted the human race can receive unlimited power from the rays of the sun. I have been told that I am the only inventor who has ever been asked to explain his invention at a special session of the Parliament of any great nation."

Asked to explain the principle on which sun power was operated, Mr. Shuman said that if a flat tin pan be painted dull black on the inside, then packed with cotton around the bottom and sides to prevent loss of heat, and a small quantity of water were poured in, covered with a pane of window glass, and exposed to the tropical sun, the water would soon begin to boil and give off steam. It is not generally known, said Mr. Shuman, that the tropical sun, without any concentration, can boil water and make steam, but such is the case.

The sun, he added, throws only light rays to the earth, and unless these rays are absorbed no heat is produced. The rays first pass through the air, and some of them are absorbed by the air and heat it to this extent. However, about two-thirds, Mr. Shuman says, pass through and strike the earth, and here again they are absorbed to an extent based on the color and nature of the surface they strike.

"When they strike water," asserted Mr. Shuman, "most of them are reflected back into space. When they strike the sands of the desert also most of them are reflected away. And even when they strike the green of the forests great losses by reflection occur. This loss by reflection may be seen by looking at the moon. The sun shines on the moon, the moon reflects most of the light off again, and a portion reaches us as moonlight.

"Now, however, when the sun's rays strike a black surface they are all absorbed and turned into heat. Were the moon painted black, then we would not be able to see it at all. Were the whole earth painted black all of the rays would be absorbed and turned into heat, and before evening a temperature high enough to melt steel would be reached and all life destroyed.

"We will admit, then, that we can collect the rays of the sun and can absorb them and turn them into heat. Now it remains to show how this can be done so as to get direct power in large quantities.

"The sun shining into that black pan I have just referred to will produce a temperature of about 250 degrees Fahrenheit, and about four British thermal units of heat per minute per square foot of surface exposed can be created in this manner. Now, however, if we catch another square foot of sunlight on a mirror and throw this also into the black pan, then we can produce eight British thermal units of heat per minute and get a much higher temperature, and so on for every additional square foot of sunlight we throw into the pan we get an additional four British thermal units and a correspondingly higher temperature. This explains what is meant by 'concentrating sunlight.'"

The reason sun power is not a practical thing in our latitudes, he explained, is not because the sun is not powerful enough, but because the percentage of hours of sunshine throughout the year is too low. At Philadelphia, for instance, the sun shines only 23 per cent. of the total daytime. Sun power must therefore search for its location in those tropical countries where there is 90 per cent. of sunlight and over, and about 20 per cent. of the total cultivable area of the earth lies, says Mr. Shuman, in tropical regions in which sun power can be used.

"Sun power plants once constructed, of course, dispense with all fuel," he asserted, "while to be practical and commercially profitable they must conform to certain requirements. They must not, for instance, cost so much to construct that the interest on the cost over and above that of a coal-burning plant of equal capacity will annul too much of the profit made by the saving of cost of the fuel. They must be constructed of such material and in such a manner that few repairs are needed, and so that they will last many years. They must be constructed strong enough to stand the heaviest gales that may occur in the localities where they are erected. And they must be sufficiently simple, so that any one capable of running an ordinary coal-burning plant can operate them.

"The present Egyptian plant," Mr. Shuman added, "fulfills every one of these requirements. The rays of the sun seem at first sight to be intangible and impossible to control in such a way as to utilize them for practical purposes. This is not the case, however. They can be caught on mirrors, thrown in any desired direction, absorbed and turned into useful heat if proper contrivances are put up to effect this purpose.

"If the tip of an ordinary tin funnel is sawed off, the interior polished, and the funnel turned toward the sun, the sun's rays will be caught and will pour through the hole at the bottom just as water would, and if a small blackened boiler were placed at this opening they would impinge upon this, be absorbed, and turned into heat. This same heat will turn the water in the boiler into steam, and this steam would give power.

"Steel has been melted with concentrated sun rays, and a sixpence has been melted in seven and a half seconds. Sunlight can be concentrated by lenses, but this would cost too much for power purposes. The concentration of sunlight by means of funnel-shaped reflectors also presents practical difficulties which make this method too costly. In order to generate steam very high concentrations are necessary, and therefore we use in our Egyptian plant five concentrations by means of mirrors. After seven years of patient experimental work and the expenditure of large sums of money we have finally solved the problem of producing mechanical power from the sun's rays and have erected a 50 horse power sun power plant at Maadi, a suburb of Cairo, in Egypt.

"Cairo is 30 degrees north, and is by no means the best place to put up a sun power plant; but it is easily accessible, and as we wanted to exhibit to the world our ability to operate it, we erected it there rather than in (we will say) the Sudan, where few people would go to see it.

"The steam is generated in sun heat absorbers, five in number, which are each 13 feet wide at the top and 204 feet long—parabolic troughs for catching the sun's rays and throwing them upon the boilers swung at the focal line. Each mirror is set at such an angle in relation to the sun and the boiler that all of the rays falling on the mirrors are thrown on to the boiler. This boiler, being painted a dull black, absorbs these rays and turns them into heat, which generates low pressure steam.

"The heat absorbers are placed about 25 feet apart, so that they will not shade each other when the sun is low in the morning and afternoon. Their axes point north and south as does that of the earth, and they turn from east to west on their axes to face the sun. The mirrors are set in a light steel framework, each one at the proper angle to throw the light upon the boiler, and consist of ordinary sheets of third quality thin window glass silvered on the back, the silvering being protected by the proper means from the atmosphere.

"At the focal line of all the light rays there hangs in the present plant a cast-iron boiler, which is tubular at the top and flat at the bottom, where the water space is. This boiler is 15 inches high and hung on light rods in such a manner that the expansion and contraction will not interfere with it. These heat absorbers are set on crescents, which roll in a system of small racks and pinions for turning the sun heat absorbers from a low eastern aspect in the morning to a low western aspect in the evening."

Asked what would be the effect of dust settling on the mirrors and on the glass, Mr. Shuman said that it would mean loss of power, according to the thickness of the dust. Labor is cheap in the tropics, he added, and 20 pence a day had been found sufficient to keep the mirrors entirely clean, the proper washing arrangements being provided.

"What will your sun power plant do when there is no sun?" the writer inquired.

"Of course, when the source of our supply is cut off we cannot get it," Mr. Shuman replied. "But we can do what is done in a great many other lines. We can store it in an already well-tried and simple manner. During the day we heat large quantities of water to the boiling point and store this in large tanks, properly insulated from the atmosphere. From this boiling water we draw during the night or during a rainy day low-pressure steam, and with this run our engine, which is so constructed that it will run economically at four pounds absolute."

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