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Operation of two-axis solar tracking by the discharge of water from a tank hanging from a non-circular sprocket wheel

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Two-axis solar tracking system operated by the discharge of water from a bottom hole of a tank filled with water was designed, constructed and tested. The water tank is hanged by a chain passing over a circular sprocket wheel mounted eccentrically on a shaft free to rotate about a North-South axis. A counterweight is also hanged by another chain passing over a circular sprocket wheel mounted on the same shaft.

In the morning, the water tank is filled to top. The water tank and the counterweight on either side of the shaft balance in such a way that the solar panel is facing the East as required. As the water drips out from bottom hole of the tank, the reduction in weight causes the shaft to rotate until the moments by the water tank and the counterweight equalize.

This study shows that a custom-designed noncircular sprocket wheel can be used instead of the eccentric circular wheel, and the contour of the non-circular sprocket wheel can be designed taking into consideration the reduction of weight of the tank with time and the required rotation for solar tracking. In addition to the hourly tracking by this mechanism, provision can be made to tilt the solar panel about the second tracking axis manually on a weekly basis to compensate for the seasonal variation of the Sun's declination. The additional cost involved in making this robust mechanism is justifiable because two-axis tracking can give about 30% more solar power on average and much more on days which are cloudy at noon but not in the morning or afternoon.

To prevent vibrations due to wind, the water tank and the counterweight can be placed at ground level and be surrounded by a shield.

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