REACTION WHEELS

Attitude Determination & Control Project

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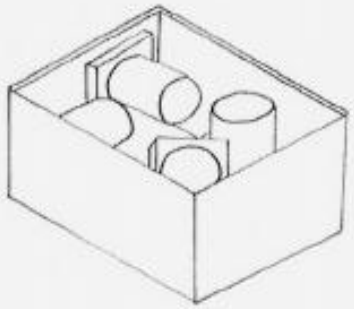
What is Reaction Wheels?

- Reaction Wheel technology is generally well-developed. Metal wheels have been used for over a century on trains.
- A Reaction Wheel is a type of flywheel used primarily by spacecraft to change their angular momentum without using fuel for rockets or other reaction devices which is for making precise adjustments in a spacecraft's orientation.

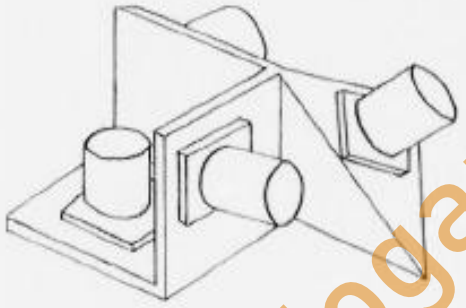
Reaction Wheels are devices which aim a spacecraft in different directions without firing rockets or jets which doesnot need any fuel. One of advantage of Reaction Wheels that the Reaction Wheels reduces weight of satellite because they donot need any fuel. Another thing is, whether it wanted to rotate the spacecraft, the spacecraft can be rotated very easily by very small amounts.

Reaction Wheels can only rotate the spacecraft around its center of mass. Which means they are not capable of moving the spacecraft from one place to another. Because of this, at least three Reaction Wheels needed for many satellites which rely on three-axis stabilization which offers high precision and independent control about axes with flexibility, to use attitude control.

Some Types of Reaction Wheels

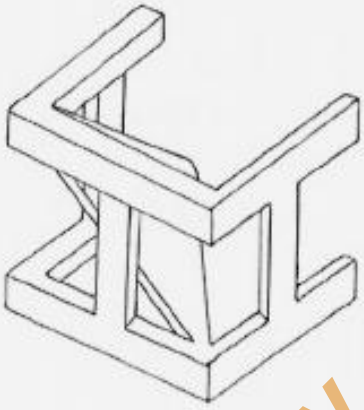


Box concept

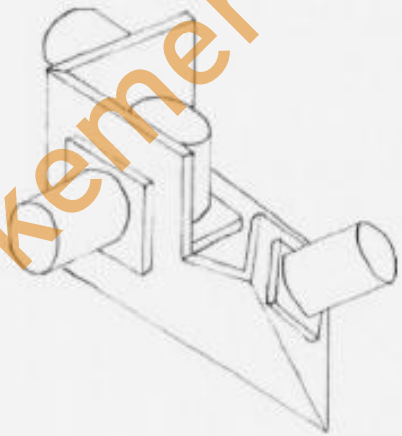


Panel concept

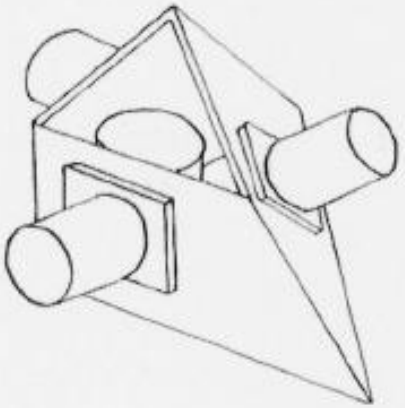
SMEX-lite concept



'I beam' concept

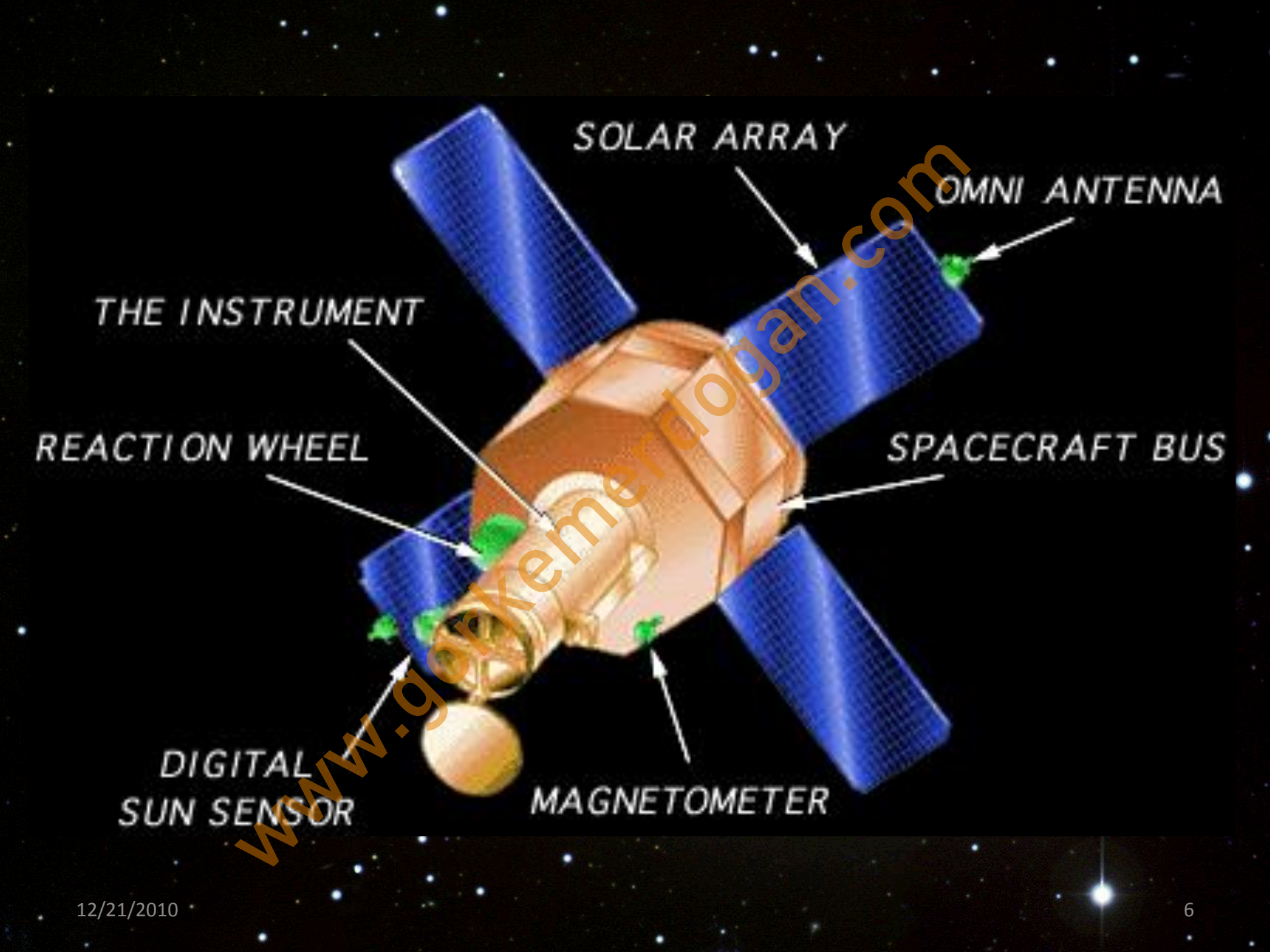


Frame concept



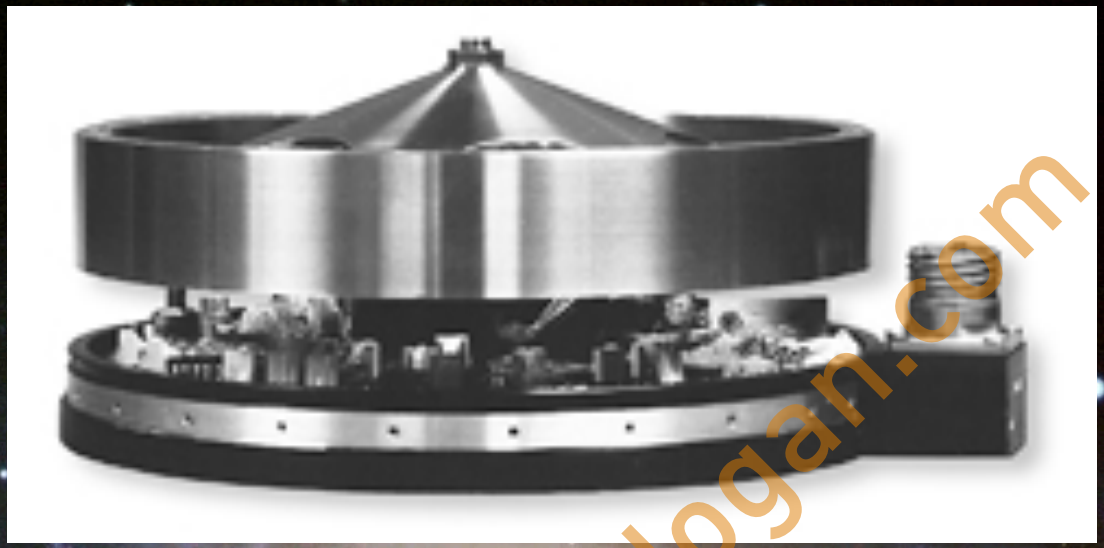
3 face concept

conceptual designs



Moreover, if you put an additional Reaction Wheel, the additional Reaction Wheel provides redundancy in the Attitude Control System.

Easily-measurable changes in a Reaction Wheel's speed provide very precise changes in angle. It therefore permits very precise changes in a spacecraft's attitude. A spacecraft's orientation can be controlled to the same high level of precision as Reaction Wheels themselves. For this reason, Reaction Wheels are often used to aim spacecraft with cameras or telescopes. And they are also have high rotation speed (~ 6000 rpm).

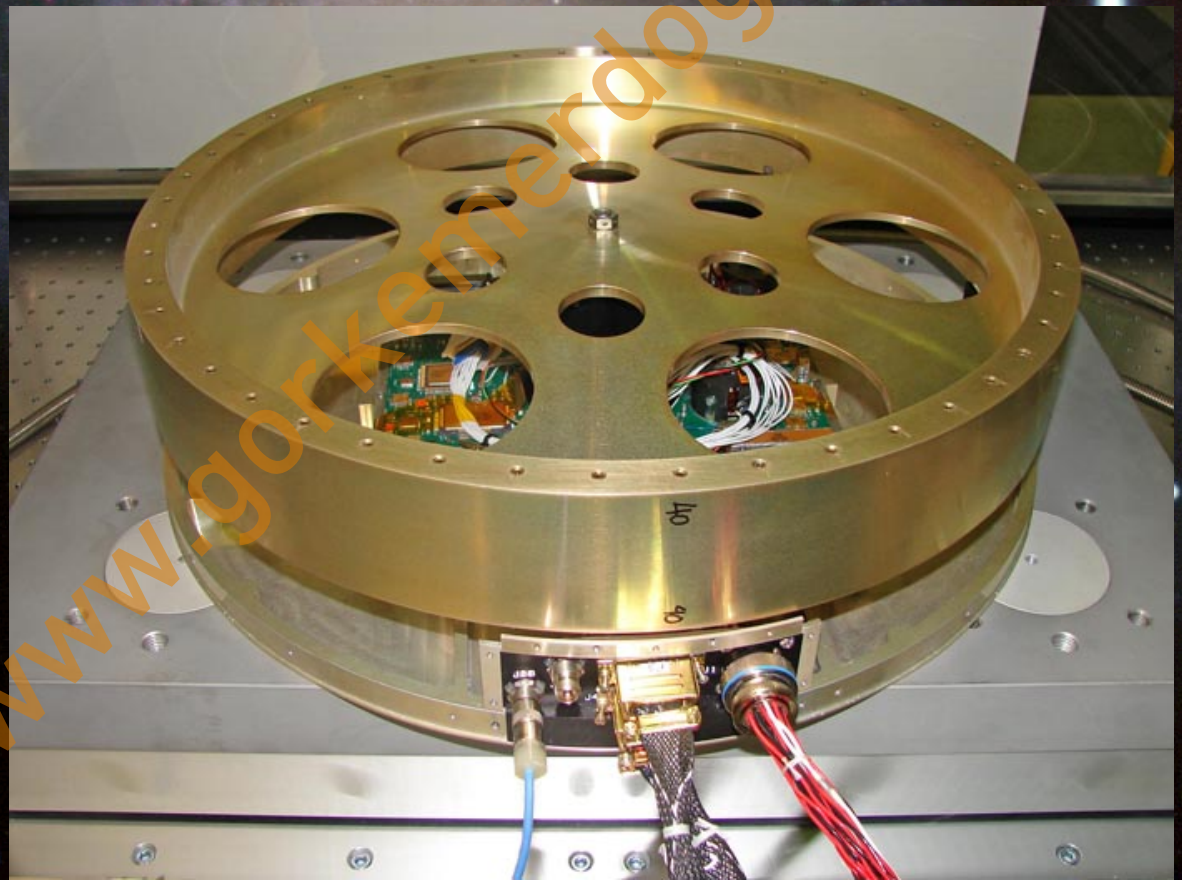


How a Reaction Wheel Works?

It operates through the principle of conservation of angular momentum. Accelerating a Reaction Wheel brings about a proportional response by the rest of a spacecraft because the total amount of angular momentum must remain the same. In other words, if a part of a system begins to spin in one direction, the rest of the system must spin in the opposite direction. Otherwise, the total angular momentum would change.

Design of Reaction Wheels

Reaction Wheels are usually implemented as special electric motors.



- Typically, Reaction Wheels are mounted separately within the satellite and leads to long wires from each Reaction Wheel to associated electronics. They are controlled by computers. For example, to change the speed rate, a direction should be given electronically by computer controls.

References

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THANKS A LOT
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