Cheap Access to Space

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Abstract
A system is described to achieve earth orbit at a lower cost. The acronym is CATS (Cheap Access To Space.) The space elevator and rockoons are discussed.

Currently, rockets are the established method to achieve spaceflight. One concern with rockets is that all the fuel must be carried from engine start on the ground, until altitude is reached. This at the portion of the flight path that has the greatest fuel demand. At liftoff the craft has to overcome the force of gravity and at a point where gravitation force on the craft is strongest. Also, the craft has to gain momentum to achieve orbital speed.

There is a very inexpensive way of achieving earth orbit. That is to use the power of lighter than air gases; especially hydrogen. At this point in time helium is the preferred choice. With helium, altitudes of better than 170,000 feet, about 32 miles, have been achieved. On a regular basis, attitudes of 80,000 to 100,000 feet are common. Helium is a somewhat limited resource and expensive.

There have been attempts in the past to use rockoons (Rocket + Balloons) to reach high altitudes. In 1957, an effort by the Air Force (called Project Farside,) using rockoons, reached altitudes of 2,700 miles. With modern electronic controls, a safe launch site, good weather forecasting and high-altitude helium balloon technology, achieving earth orbit with some of the more powerful amateur rockets should be possible. This would be an inexpensive method to gain access to space, compared to current efforts. Collaboration between a hydrogen balloon club and a model rocket club might be able to get a small satellite into orbit. Surplus cruise missiles launched in the same manner would likely achieve orbit and could carry heavier payloads. With due diligence, an appropriate Non-Governmental Organizations (NGO,) might be able to acquire surplus cruise missiles.

Since the 1937 Hindenburg dirigible disaster, there has been an almost irrational fear of using hydrogen as a lifting gas. Hydrogen has a great lifting capacity and unlike helium is easily renewable. The use of hydrogen gas should be explored. It is this author's opinion, the Hindenburg had a serious design flaw. The hydrogen gas was kept in cells within the fuselage. This allowed any leaking hydrogen to accumulate within the fuselage and mix with oxygen.

Some hydrogen balloons are being used. Currently, the balloons are partially filled and the gas expands as the balloon reaches higher altitudes. Eventually, the envelope bursts when sufficient gas expansion occurs. A small, mechanical or electronic devise could be used to control a gradual release of the hydrogen from the envelope to achieve greater altitudes. Additionally, the one gas which is lighter than hydrogen is heated hydrogen. A small battery-powered incandescent lamp could be switched on at the highest altitude achievable by the hydrogen. This might be enough to heat the hydrogen sufficiently to gain additional height. Another method might be to use solar energy to heat the remaining gas and provide more lift at extreme altitudes. With a more mature technology, balloons reaching 60 miles might be possible.

A great effort is required for the rockoons to work with heavy launch vehicles. The balloons would need to be exceedingly large. Switching from balloon lift to rocket lift would be difficult. The larger balloon requires a greater separation distance. With smaller rockoons, accidentally igniting the smaller hydrogen balloon is almost inconsequential. With larger balloons there is the possibility of disrupting the flight path of the craft and debris falling to the ground, if the hydrogen is ignited.

There have been discussions on the feasibility of a space elevator. This would be a tether attached to the earth at the equator and stretching to, at least, a geosynchronous orbit. This would allow a payload to climb the tether and be deployed to an orbit. This would achieve access to space at a much lower cost. Currently, the technology is not mature enough to achieve a space elevator. There are many concerns with the project, but the deal killer, at this time, is that no material strong enough for the tether is available.

There might be a method of implementing a space elevator. A launch platform above ninety percent of the atmosphere would put the space elevator's tether within reach. The solution could be a hydrogen hoisted platform. Hydrogen would be considered because it is easily renewable, inexpensive and has very good lifting capabilities. The amount of hydrogen in the lifting cells would be adjusted on a real time basis. This is necessary when using hydrogen, because the gas is "leaky." The hydrogen molecule is so small it tends to leak through most barriers and it embrittles some materials.

That leakiness is a concern that needs to be addressed. Hydrogen is extremely flammable because it will ignite between 4% and 75% concentrations. Further, unlike other flammable materials, hydrogen requires very little energy for ignition. The reason hydrogen is being considered is that hydrogen weather and amateur balloons are currently being used. There is a nominal amount of leakage with the correct skin material. A careful selection of the cell material will lessen the hydrogen loss. Any gas that does leak is quickly dispersed by rising and the ambient wind. Confirmation is needed, that the leakage rate is low enough that dangerous concentrations of hydrogen are not created.

The hydrogen hoisted platform mentioned above, would consist of individual segments at one thousand foot increments. Taller segments are possible, but this design allows less expensive materials to be used and makes the structure more easily engineered. The amount of lift (hydrogen) at each segment can be adjusted to carry its own weight and the necessary weight for the other segments, with only a small amount of force on the ground anchors.

The initial segment would be anchored to the ground with reusable disconnects, a platform attached to the top of the cables and the hydrogen cell installed. A pressure transducer and a hydrogen feed tube are incorporated into the lifting cell. The cell would be inflated and the segment hoisted to the 1,000 foot height.

Additional platforms would be attached between the previous segment cables and the ground anchors, one at a time. The cables between the platform and the ground anchors would be attached and then the segments hoisted. When the third segment is installed, a control mechanism is air lifted to the top of the three thousand foot tower.

The control mechanism would consist of solar cells, batteries, two motors, with propellers, and associated control systems. The motors/propellers would be mounted on opposite sides of the mechanism, with powered gimbals to control up or down forces. The mechanism would be mounted on a computer controlled rotating deck, that would mate to the upper platform of the tower. When in operation, this would keep the tower vertical, regardless of weather conditions.

The platform could have two additional trusses extending past the edges. These would be for a lightning arresting cable and for a hydrogen powered lifting system. Lightning and hydrogen cells do carry a hazard. The hydrogen airships of the past were subjected to lightning strikes and experienced no catastrophic loss due to the lightning. With an extremely high tower of any sort, lightning protection needs to be analyzed and addressed.

The other truss could have a cable extending the length of the tower. This could be used as an elevator to move material from ground to upper levels. With safety protocols, this elevator could be powered by hydrogen. Alternatively, the hydrogen cells could be designed so there is a circular shaft running the length of the tower. This could be used to transport material. Powering this type internal elevator with hydrogen would increase the risks of hydrogen entrapment and mixing with oxygen.

At 3,000 feet, a design re-assessment could be made. The tower, as completed to this point, would be kept elevated and controlled for a period of time. The questions are: Is it safe? Does it work? Is it stable? How much hydrogen is needed? How much tension is required on the anchor points? Does the hydrogen control (filling/release) act quick enough? If one of the cells is ignited, does the tower survive? If the tower collapses, does the control mechanism prevent the tower from falling 3,000 feet down range or can the control keep the debris contained?

At this point, the tower could be built to unknown heights. Possibly, 32 miles or about 150 or 160 (thousand foot) segments. There is no reason , the tower could not be lowered and raised to some extent, by releasing the hydrogen from specific cells/segments. The height and stability of stacked deflated platforms determines these limits. Conceivably, lowering the tower to 30,000 to 35,000 feet would allow cargo planes to land at the top of a large tower. Then the tower and cargo, perhaps an assembled rocket, could be hoisted to the tower's upper limits.

Depending on the design, very heavy rockets could launched from the tower. The design of the upper platform would need some consideration for protection from the rocket blast debris. If the tower can be stabilized at 32 miles, the space elevator tether might become feasible.