The Rocket which Returned to its Cradle

Herman Oberth proposed the recovery of a launched rocket in his book ‘The Rocket into Planetary Space’ already in 1923:

“Place of Descent: Although my rocket appears to ascend vertically, it does not fall back to the same place from which it lifted off. First, it is influenced by laterally moving air layers (the horizontal component of their movement is nearly equal to the lateral movement of the higher air layers). Second, a deviation comes about for cosmic reasons. Due to the rotation of Earth, the rocket moves under a great circle drawn around the celestial sphere as observed from the intersection of the plumb line with Earth’s axis. Initially, this circle runs exactly from west to east, but later deviates toward the equator, unless the launch site itself lies on the equator (cf. Fig. 8). Furthermore, the angular velocity of the rocket referenced to the center of Earth is less than the angular velocity of the point on the surface of Earth over which the rocket is currently located. This causes a deviation to the west. In Fig. 9, the arrow connects the geographical points over which the rocket flies. ***This curve can be easily calculated****. Thereby, recovery can be facilitated.” [1]*

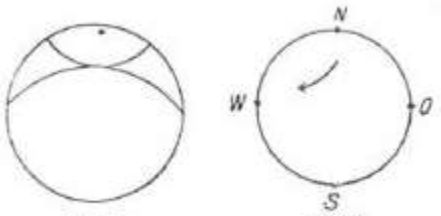

Fig. 8. Fig. 9.

It turned out that a recovery is not that easy, although during the Apollo-days rocket stages were recovered after splashing down in the ocean, and Elon Musk recovered several Falcon 9 stages by landing them softly on a recovery ship platform since 2015.
Approximately 100 years after Oberth’s proposal Elon Musk’s Space X company successfully guided a rocked stage back to its launch pad after it has completed its mission, thus reducing the ‘turn-around time’ significantly.

Wow! Screenshots of Starship recovery from YouTube video

SpaceX on Sunday (Oct. 13, 2024) achieved the recovery feat on the fifth integrated test of its Starship spacecraft and Super Heavy booster. The nearly 400-foot-tall (121-meter), steel-skinned vehicle sent the Starship into space at 8:25 a.m. EDT (1225 GMT or 7:25 a.m. CDT local time) before the Super Heavy relit some of its 33 engines to fly back to SpaceX's Starbase production and launch facility in Texas.
As Super Heavy lowered itself next to its launch tower, two large mechanical arms pinched the rocket's body, catching it like a pair of chopsticks. [2]
But SpaceX's historic rocket catch earlier this month was even more dramatic than it looked. That catch occurred on Oct. 13, during the fifth test flight of SpaceX's Starship megarocket. Starship's huge first-stage booster, known as Super Heavy, came back to Earth about seven minutes after liftoff, nestling next to its launch tower, which secured the rocket with its "chopstick" arms.

But that epic moment almost didn't happen: Super Heavy was just one second away from aborting the launch-tower landing and crashing into a patch of nearby ground, SpaceX engineers told company founder and CEO Elon Musk after the recovery. [3]

Historical significance

The successful return of a rocket stage to the launch pad, achieved by SpaceX under Elon Musk's leadership, marked a groundbreaking milestone in spaceflight and launched a new era in reusable rocketry.Historically, space rockets had been designed as expendable vehicles, meaning that each stage would be discarded after use, often falling into the ocean or burning up in the atmosphere. This "disposable" model, while functional, resulted in high costs, as every mission required building a new rocket from scratch. Elon Musk and SpaceX sought to change this by developing a rocket that could return to Earth safely and be reused, reducing the costs per launch significantly.

The successful landing of the Falcon 9's first stage on a ground pad at Cape Canaveral, Florida, proved that rocket reusability was not just feasible but also reliable. This development has had several historical and technological impacts:

1. **Cost Efficiency and Commercial Spaceflight**: The ability to reuse rockets drastically reduces the cost of launching payloads into orbit. This made space more accessible to a broader array of clients, including small satellite companies, academic institutions, and even space tourism ventures. Lower costs also mean more frequent missions, further accelerating innovation and scientific discovery.
2. **Shift in Space Industry Standards**: SpaceX's success pressured other aerospace companies to explore similar reusable technology. This has sparked a competitive wave of innovation in space technology, influencing the strategies of established space agencies like NASA and commercial companies such as Blue Origin.
3. **Sustainability in Space Exploration**: Reusability aligns with the global shift towards sustainable practices. By reusing rockets, SpaceX reduces the waste associated with single-use rockets, minimizing both environmental impact and resource consumption.
4. **Vision for Mars Colonization**: For Musk, this achievement was a crucial step toward his long-term vision of colonizing Mars. Making space travel sustainable and cost-effective is essential for interplanetary travel and eventual human settlement on Mars. The development of reusability in rockets lays the groundwork for future advancements that will be needed for these longer, more demanding missions.

The return of a rocket stage to the launch pad was not just a technological success but a historical moment that reshaped the ambitions and possibilities of space travel. It underscores the potential for a future where space is more accessible, sustainable, and within reach for broader humanity.

References

[1] Herman Oberth: Die Rakete zu den Planetenräumen (The Rocket into Planetary Space). Original publishing date 1923

[2] http://www.collectspace.com/news/news-101324a-spacex-starship-super-heavy-test-flight-five.html#:~:text=%E2%80%94%20For%20the%20first%20time%2C%20a,spacecraft%20and%20Super%20Heavy%20booster.

[3] Space.com https://mail.aol.com/d/search/keyword=space.com/messages/AIal43oUsPeTZyDanQFzGBOOXuw