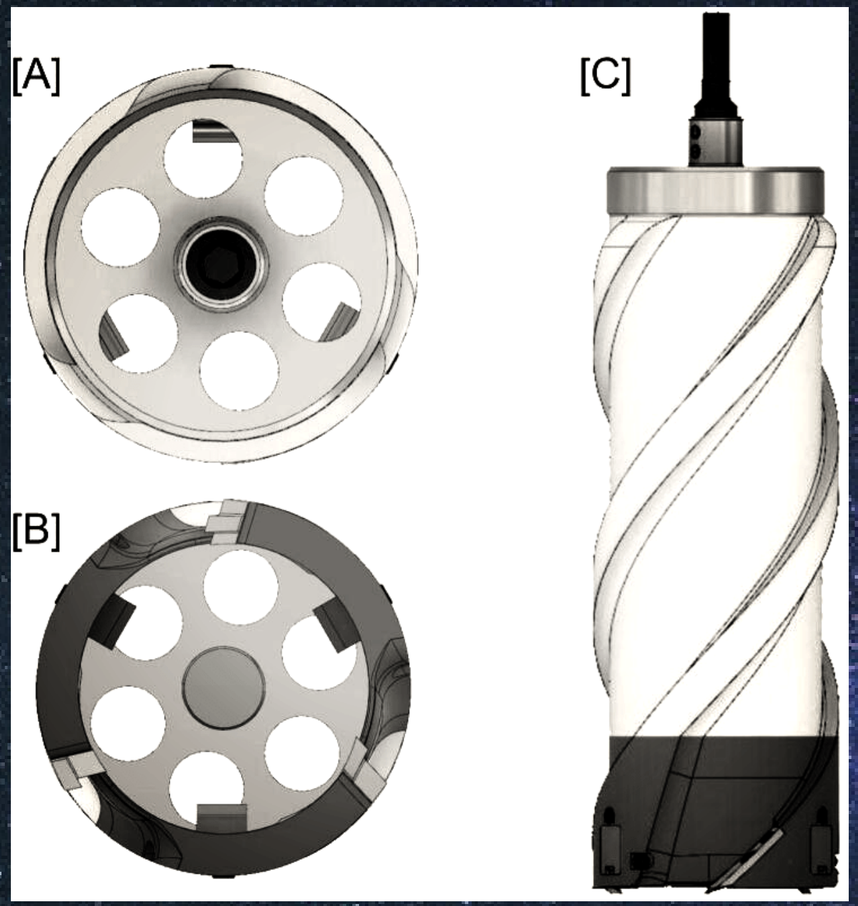
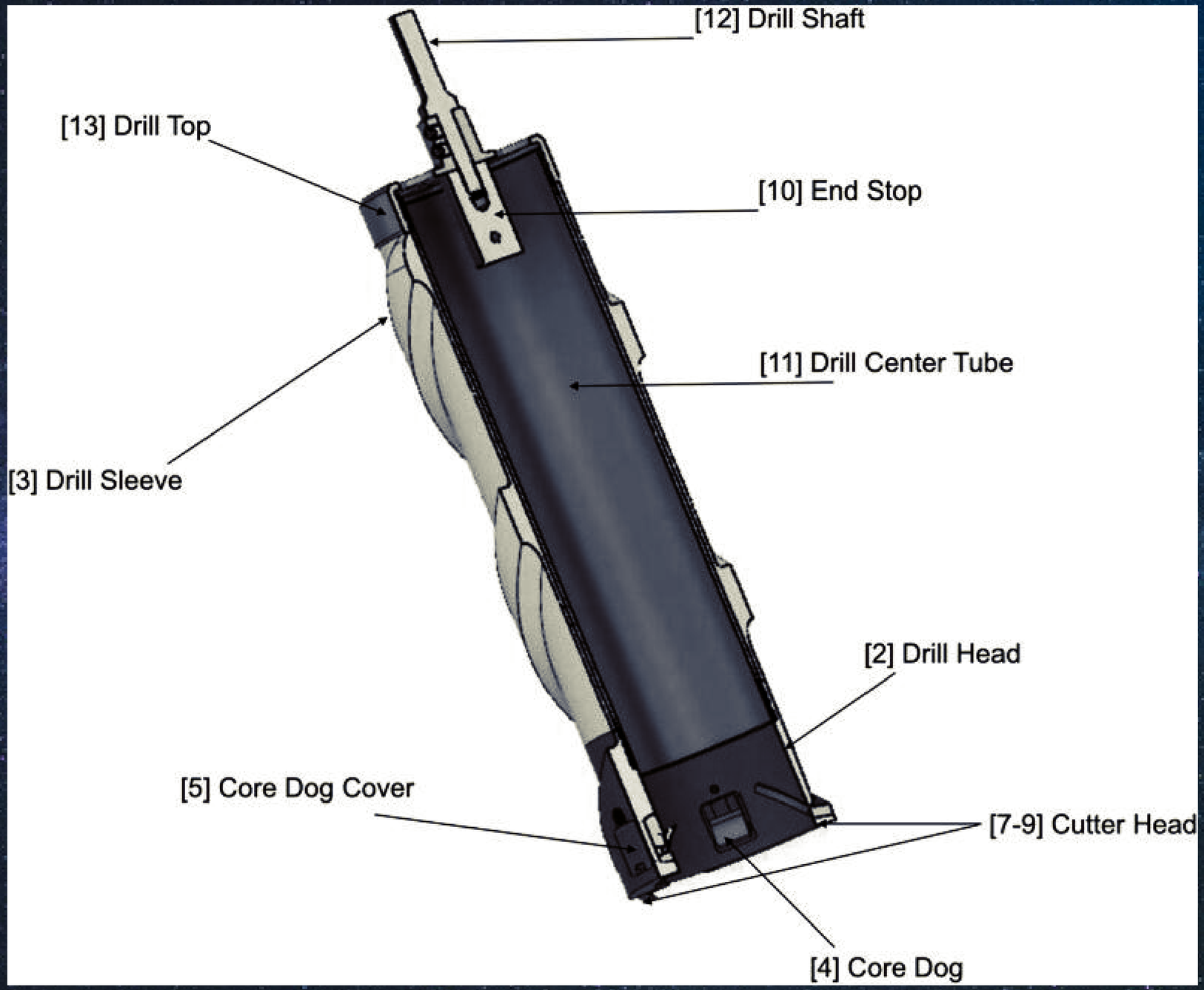
The Ultra Compact Space Drill

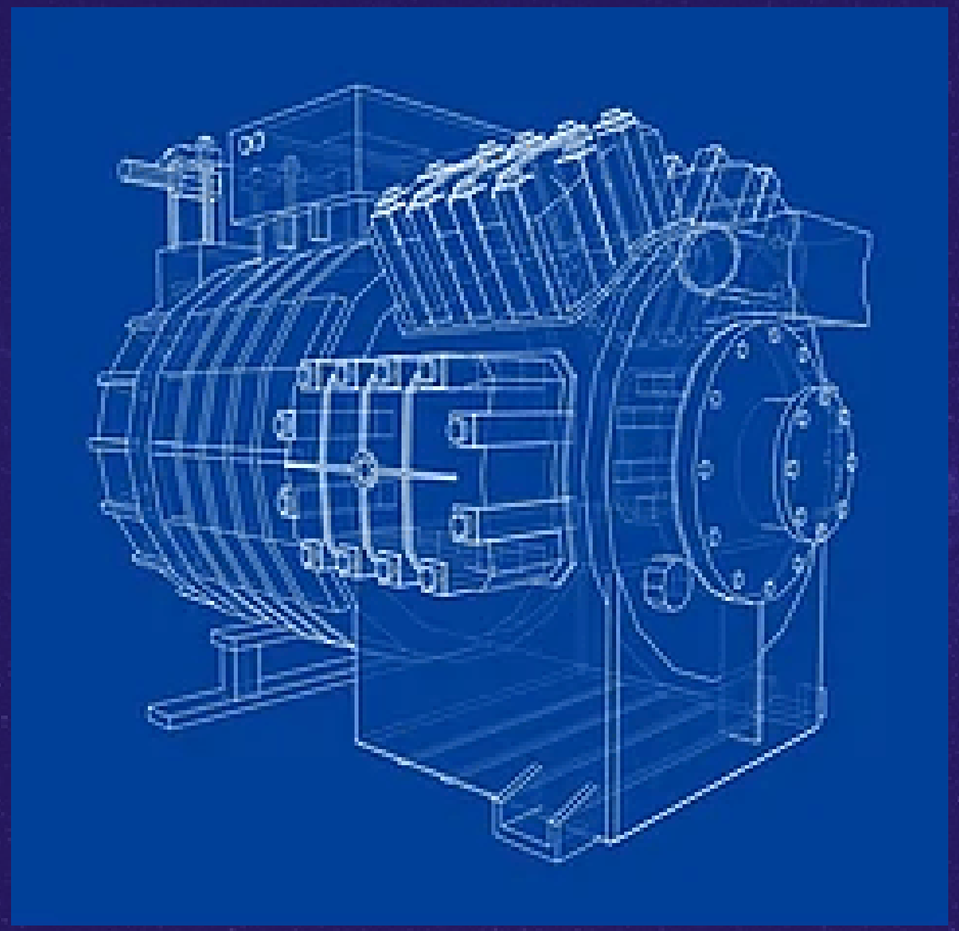
An Ultra Compact Ideation By Semi-Infiknight

Assembly of
the Drill



BASE PROTO-DESIGNS OF THE DRILL





THE ICE PULVERIZATION SYSTEM

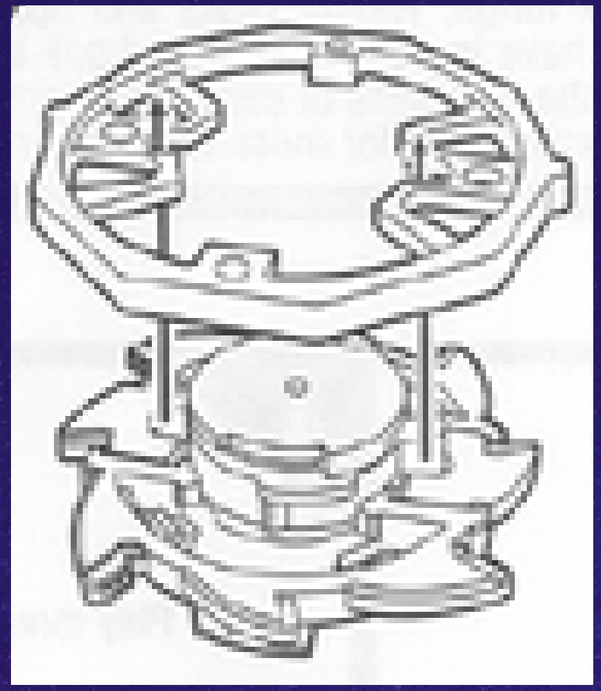
THE PROBLEM

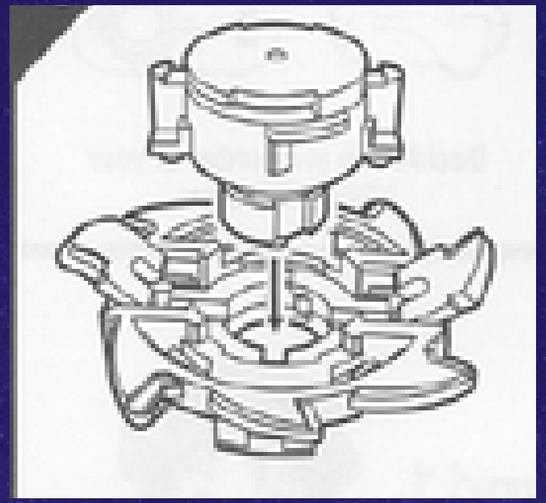
The drilling breaks up the ice into chunks. We need to compatify the ice to store it as a sample. The conventional method is to pulverize it using blade cutters, but the blades wear out over time and in space there is no way of repairing them.

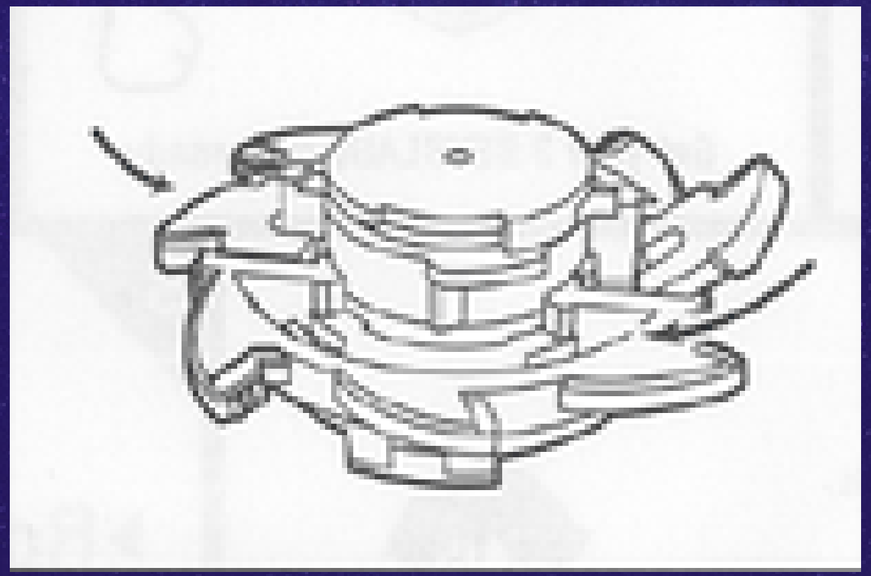
THE SOLUTION

Our drill will use a Supercooling and Nucleation pump method to decrystallize the ice crystals and compress it into a cylinder using high air pressure system. There will be no wear of parts using this method, and it will be highly efficient and powerful too.

THE REV ENGINE GEAR

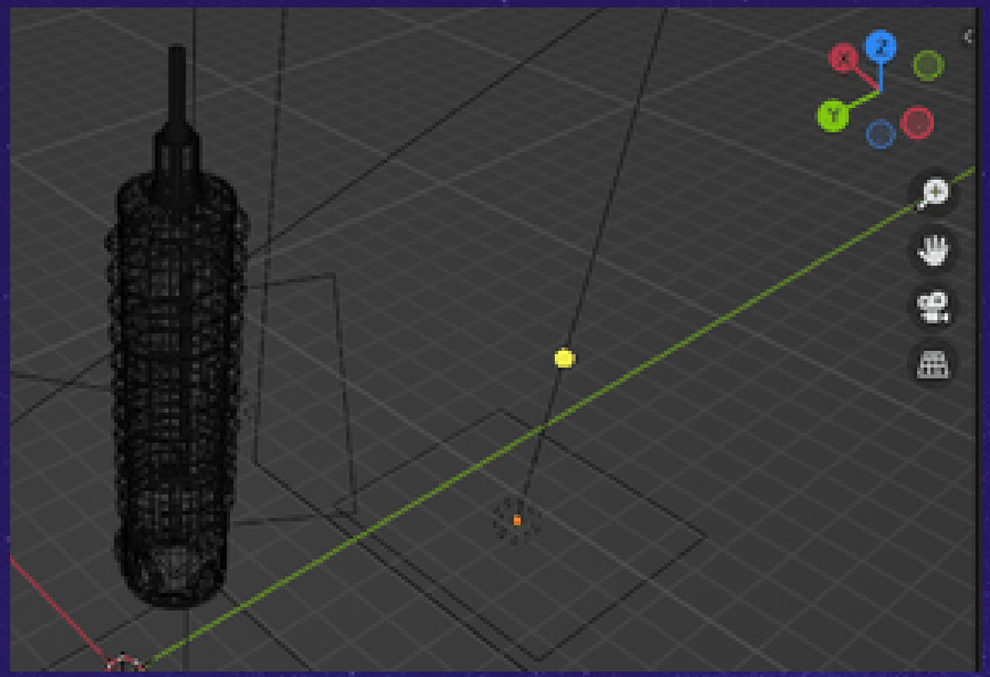






How does it Work

Drilling Ice Core is a High Energy Process. Space Rovers mostly rely on solar energy. For optimizing the drill's rotational energy and making it more efficient, the shaft of our drill will be fitted with this Engine gear system. The system will get winded in the opposite direction of the drill's original rotation during the first drilling process. The Engine Gear will then give a boost to its rotation when it is revved up the second time. After revving up, it will again get winded in the opposite direction and provide the boost in the next rotation.



MAJOR MATERIALS

METALLIC GLASSES

They will be the major reinforcing material as they possess high physical and tensile strength, don't become brittle and don't wear out too quickly.

LEXAN AND PLEXIGLASS

They will be used together in making the casing and shell parts of the drill.
They are highly durable and can tolerate extreme temperatures of space.

POLYOXY METHYLENE

It will be used in making precision parts of the drill requiring high stiffness, low friction, and excellent dimensional stability.

POLYCRYSTALLINE DIAMOND COMPACT

Our drill head will be made out of PDC fused with custom-made carbide. It will give us a high penetration rate with low drill loads of around 500–1200 N.

TESTING OF THE ICE CORE

THE ROVER WILL FOCUS ON TESTING THE MAJOR GASEOUS COMPONENTS THAT ARE BELIEVED TO BE ESSENTIAL TO TRIGGERING THE CHEMICAL PROCESSES THAT SUPPORT LIFE.

The rover uses a method combining wet extraction, gas chromatography and mass spectrometry, for high-precision, simultaneous measurements of seven air components (CH_4, N_2O and CO_2 concentrations, $\delta^{15}N$, $\delta^{18}O$, $\delta O_2/N_2$ and $\delta Ar/N_2$) from an ice core samples. The ice sample is evacuated for some time and melted under vacuum, and the released air is continuously transferred into a sample tube at 10 K within 10 minutes. The air is homogenized in the sample tube and split into two aliquots for mass spectrometric and gas chromatographic measurements.

POWER BUDGET FOR THE DRILL

Within the range of drill loads of 500 to 1200 N and rotation speeds of 50 to 200 rpm, the maximum torque is no more than 45 Nm, and the power consumption is less than **0.8 kW.** In addition, the temperature changes of the bit cutters caused by their cutting actionshow that temperature variations increase from 3.67 to 5.96 ˚C when the drill load increases from 450 to 1200 N and from 4.17 to 6.21 ˚C when the rotation speed increases from 50 to 200 rpm.

THE DRILL WOULD USE THE RADIOISOTOPE THERMOELECTRIC GENERATOR FROM THE ROVER FOR ITS POWER.

DRILLING SITES

Europa's surface is covered with closely spaced ice spikes, called penitents, as tall as 15 meters (50 ft). The drill would first take out ice core samples from those.
Then the rover would descend between the deep cracks of Europa's icy surface which are around 600 feet deep and would take out the major ice core samples needed.

$2.1M

Estimated cost of the drill
(Well its a space tool)

0.315 L

Volume of ice core sample
will be taken out by the drill

200*150*1100

mm^3
Dimensions of the drill

FOR INSPIRATION

"This is the drill that will pierce the heavens!"

-KAMINA
(Tengen Toppa Gurren Lagann)