Apparatus for collecting and destruction space debris
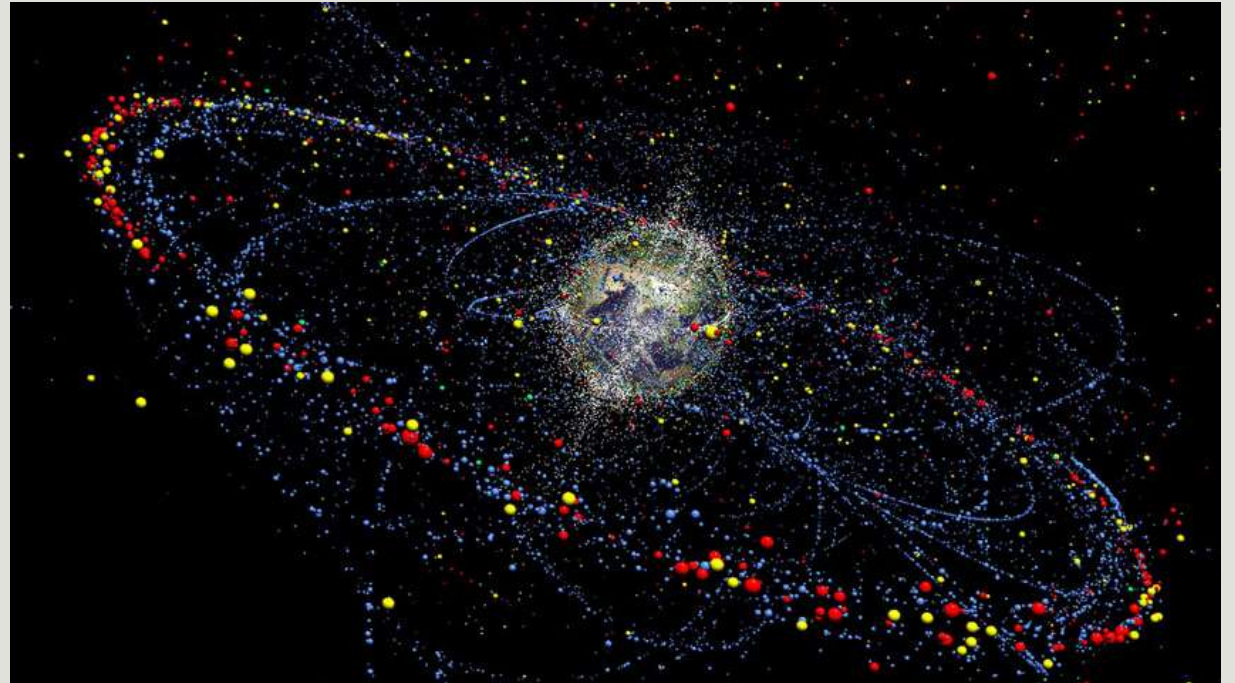
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Space debris in the Earth's orbit appeared at the same time when the first spacecraft began to be launched. But for today this problem has acquired a truly menacing scope. The problem of space debris was brought to the international arena on December 10 1993, Secretary-General of the United Nations. The report was called "The impact of space debris on the environment."

Space debris means all artificial objects in space that no longer function and can no longer serve any useful purposes: all kinds of fragments of satellites, rocket stages, etc.

Space debris poses a potential threat to spacecraft due to the possibility of collision. Since fragments of space debris move in their orbits with very high velocities, they can cause serious damage to spacecraft, even with a low mass. In 1983, a small grain of sand (less than 0.2 mm in diameter) left a serious crack on the shuttle's porthole.

In addition, space debris can pose a danger to the Earth: in case of incomplete combustion in the atmosphere when it falls to the ground, garbage can also contain radioactive and toxic substances.

Composition and amount of space debris for 2010

The table shows that the vast majority of space debris is less than 10 cm in diameter.

Composition of space debris	Amount of space debris
<1 cm	>100 000 000
1-10 cm	>500 000
>10 cm	>21 000

Device prototype

We offer our prototype of a space debris collection and destriction apparatus. It consists in the impact on objects of space debris magnetic field by an electromagnet mounted on an unmanned spacecraft. When exposed to metal space debris by a magnetic field, two scenarios are possible: 1) we draw garbage to a magnet and collect it for further processing; 2) we reduce the kinetic energy of the object, which leads to the impossibility of its further movement in orbit.

The conditions for finding the body in the Earth's orbit as a satellite are found from the following equation (air resistance is neglected):

$$G\frac{m*M}{r^2} = \frac{m*v^2}{r}$$

G – gravitational constant;

M – mass of the Earth;

m – mass of object;

r – distance to the center of the Earth;

v – velocity of object.

From this equation we find the velocity of the body:

$$v = \sqrt{G\frac{M}{r}}$$

If we reduce the speed of the body, then it can no longer remain in orbit and will begin to fall. We are going to change the speed of space debris using an electromagnet. The device in orbit will also have a very high speed, so the relative speed of debris and apparatus will be small. As an electromagnet it is possible to use a copper wire wound on a core of transformer steel. In fact, it will be a solenoid with a core. The induction of the magnetic field inside the solenoid is found from the formula:

$$B = \mu\mu_0 \frac{N}{l} I$$

μ_0 - magnetic constant;
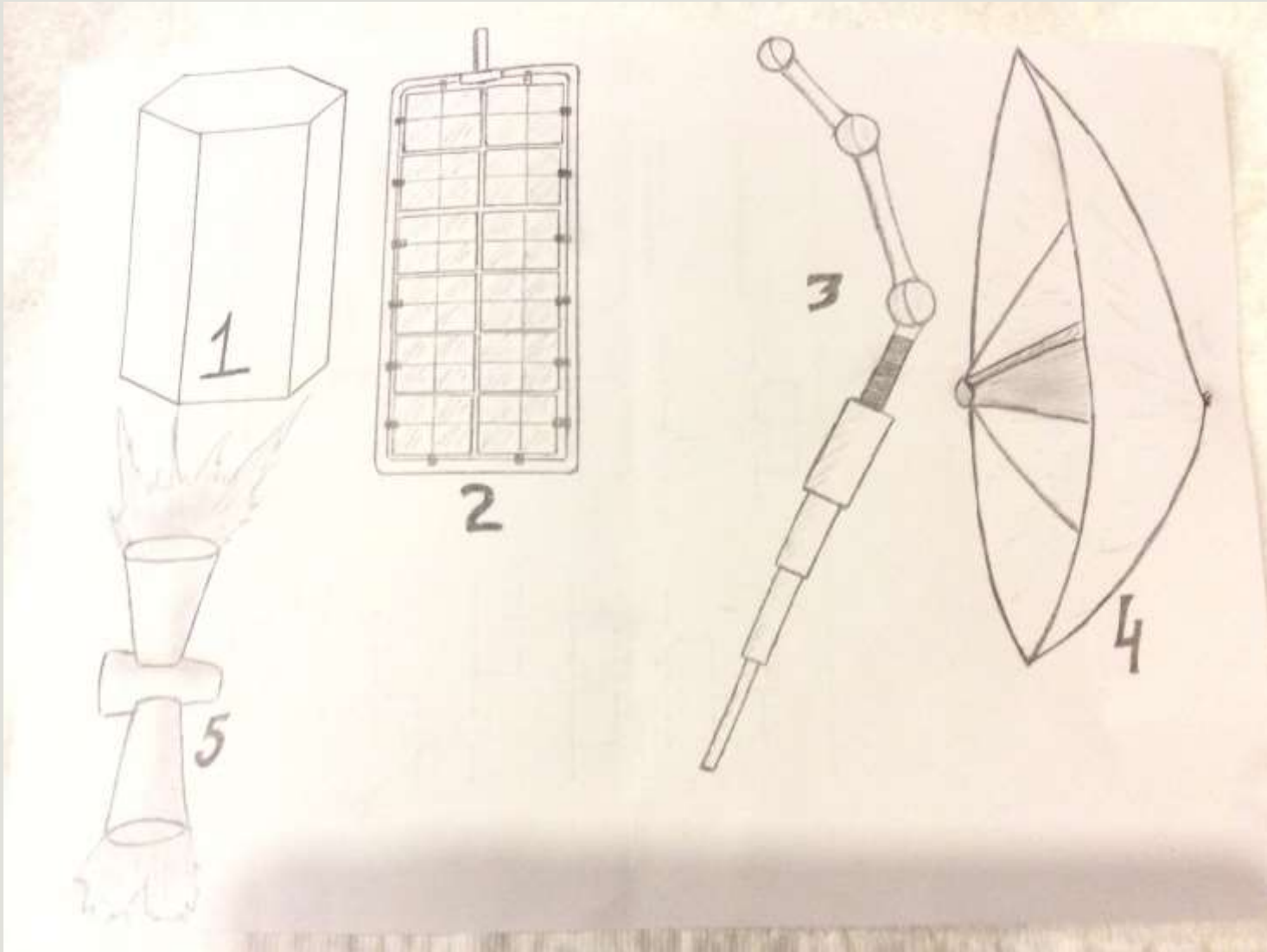μ - magnetic permeability of the core material;
N - number of turns of wire;
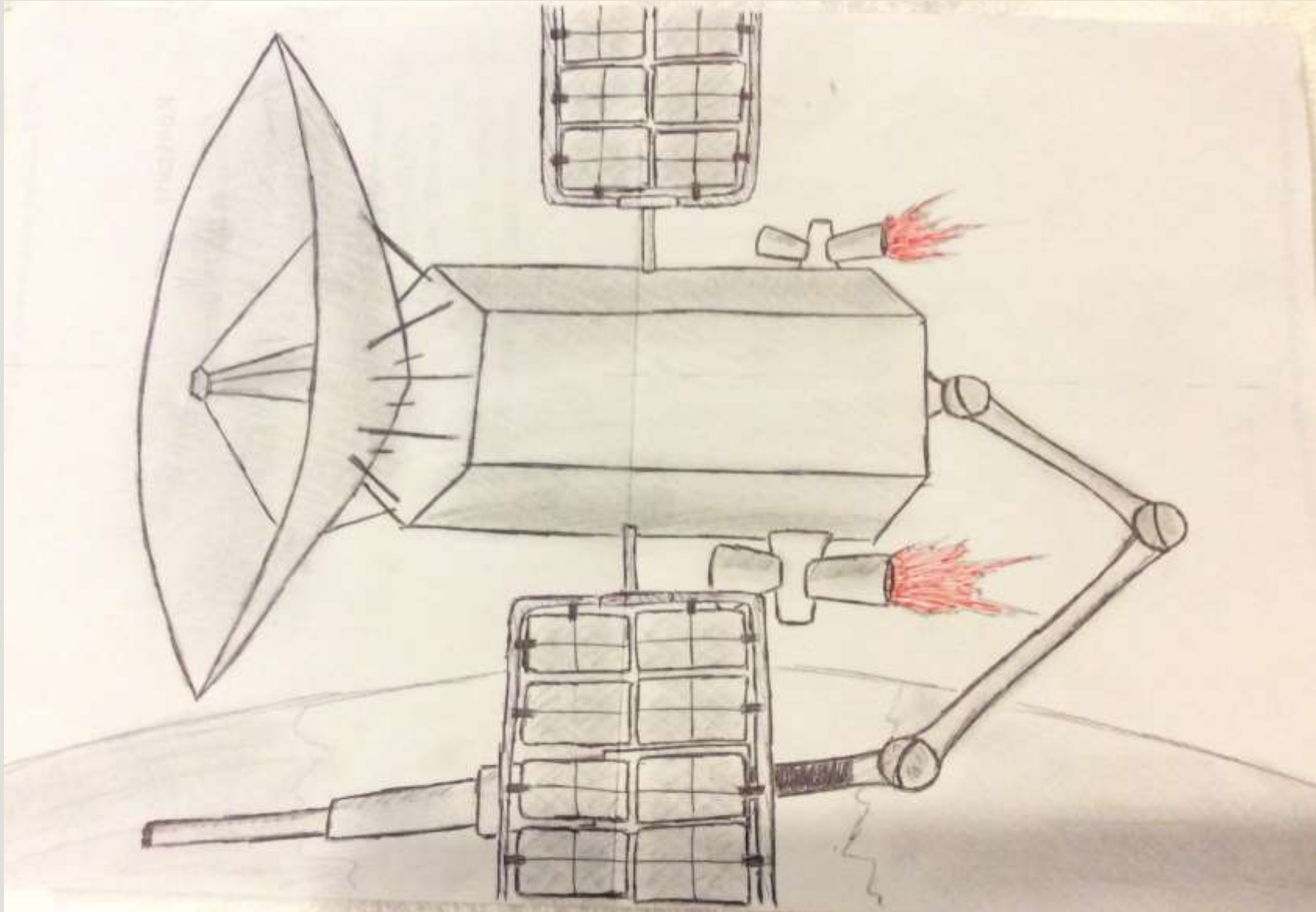l - solenoid length;
I - amperage.

Since most of the garbage objects are less than a centimeter across, in most cases, the magnitude of the magnetic induction will not be too high.
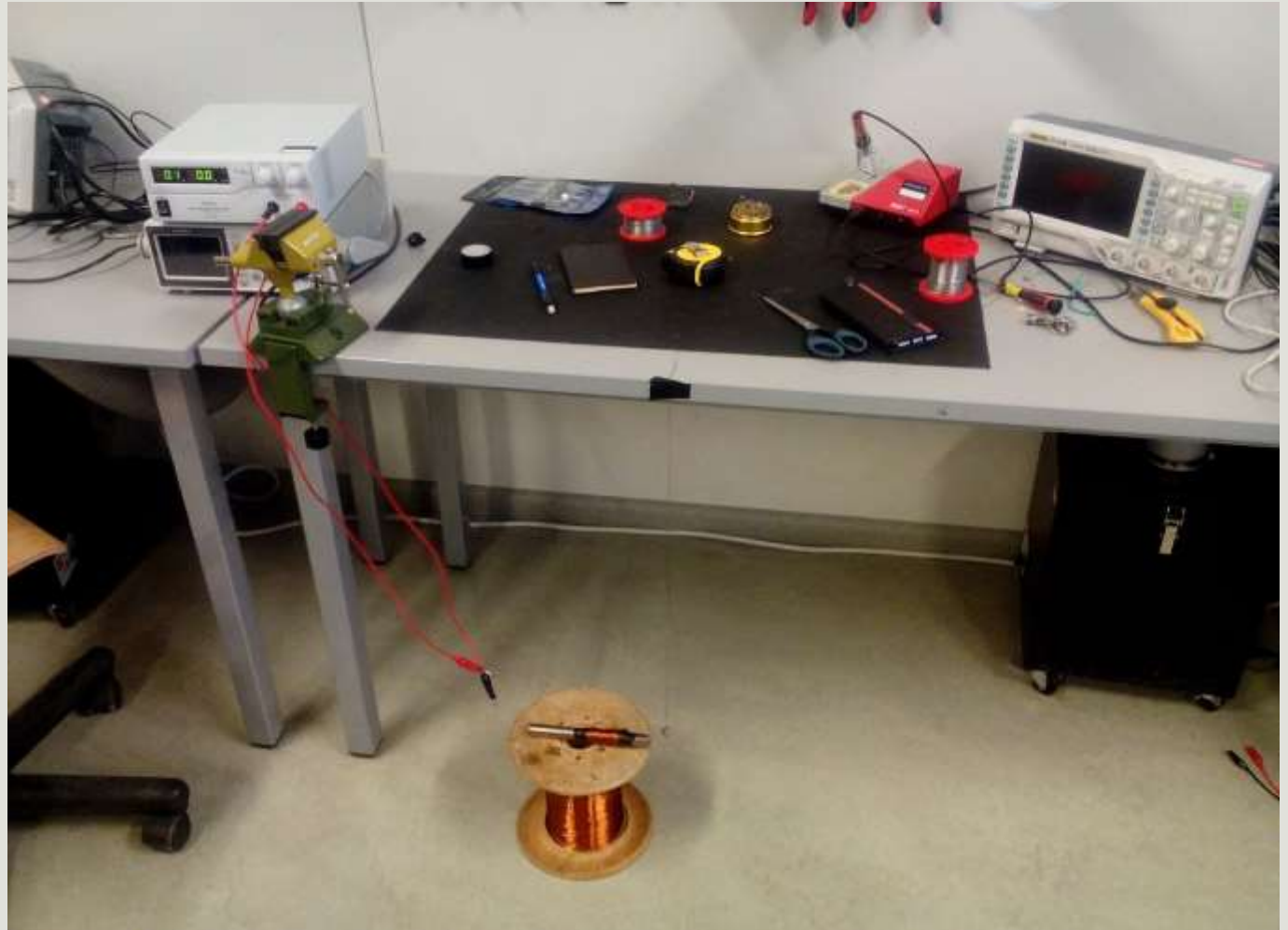
The main parts of the apparatus

1- Body
2- Solar panels
3 - Electromagnet on movable manipulator
4 – Locator
5 - Shunting engines

Sketch of apparatus

For the copper winding, a cooling system and protection against external damage should be provided. Various modifications are possible for the device: it is possible to equip a container for collecting garbage, a more perfect magnet, etc. All these are questions for further development.

Thank you for attention!