

# Electrical propulsion device with improved propulsion force using electrostatic and flame jet EHD power generation

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## Abstract

A principle for the propulsion system that uses electrostatic and flame jet EHD power generation which has been greatly improved in propulsion force had been shown, and an experimental result had been also shown as one example. Electro hydro dynamic (EHD) and electrostatic propulsion devices were developed in the 1920s by Thomas Townsend Brown. One such device, has no moving parts and, in the air, operates on electrical energy. In addition to the conventional electrostatic and EHD propulsion unit, a weakly ionized plasma column (flame jet) is installed at the center in the device to improve the propulsion force. Voltage was amplified by flame jet inside the center column and boosted to close to 200 kV.

## 1.Introduction

It is expected to develop electric propulsion systems without future moving parts of airplanes and helicopters propellers in the future. The advantage of this propulsion system is that 1) there are no moving parts, easy to maintain and 2) the propulsion efficiency may exceed the conventional engine.

There is a report that the principle of ion craft considered as a part of a series of thrust generation experiment by Brown effect using high voltage is propulsion by the imbalance of electrostatic force, attraction by space charge. We also think so from many experimental results other than that paper. However, if you propel using electrostatic attraction force, propulsion force does not improve greatly and it reaches the limit. In the system introduced so far, the thrust density (N / kg) is low and it does not exceed the self-weight of the case where the power supply is mounted. In other words, as a result of repeated experiments and other reports so far, it has been concluded that it is difficult for overcoming the weight of high-voltage power supply (including Li-ion battery, booster circuit, transformer, etc.) by exceeding the propulsive force whenever the shape is improved. Our goal is not to fly horizontally but to overcome gravity by using VTOL. In the airplane, it is possible to propel even if its propulsion power is lower than its own weight. In order to make VTOL using EHD propulsion, propulsive force sufficiently must exceed its own

weight.

## 2. Principle

Figure 1 shows the principle of a new propulsion system. In addition to the conventional EHD propulsion theory, static electricity which is the opposite of the summary of the paper report so far, that is, using the repulsive force of the same poles in the confined space as a driving force. In order to increase the pressure of the gas, confinement of ions and electrons is carried out in an insulator or a long metal cylinder which can withstand high temperatures. Until now, since the atmospheric pressure was used, propulsion power was limited. Based on the idea that the EHD propulsion principle is based on the ionic wind, not the generation of force due to the electrostatic attraction force of ions, the new idea in this time cannot even be reached.

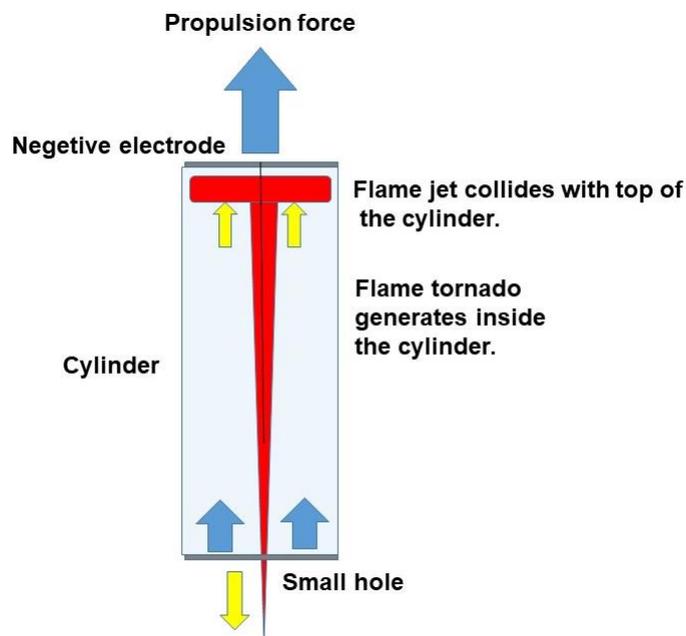


Fig.1. A new principle.

For conventional rocket propulsion, fuel is burned to propel upward in the vertical direction due to unbalanced pressure. First, a flame (weakly ionized plasma) jet inside the cylinder is used. The weakly ionized plasma column shown in Fig. 1 is installed in the center of the conventional EHD propulsion system. Arrange the negative connection line inside the cylinder. Utilizing electron transfer due to the rise of combustion gas from bottom to top. After fuel gas ignition, a flame is generated. When the gas burns, electric charges (electrons and ions) are distributed inside the cylinder. The flame attracts electrons and the central column becomes a high negative potential. A high voltage is generated using internal jet flame. At this time, the electrons rise on the surface of the combustion shock wave. Some electrons are emitted to the outside of the cylinder. The

plasma is a non-equilibrium plasma. A flame tornado occurs below in the center. The tornado is made up of sheath of electrons and ions. Internal pressure rises, a plasma pinch effect due to self-magnetic field occurs, and the rotation speed of the flame jet becomes high. Some flames are released to the outside through the hole under the hole. As a result, an upwardly accelerated flame jet including ions and electrons collides with the upper surface of the cylinder, and a large thrust is generated at that time.

### 3. Experiment example of vertical upward propulsion experiment

A propulsion device is shown in Fig.2, as an example. In addition to the conventional EHD propulsion unit, a plasma column is installed at the center in the device. Fuel gas is ignited under butane gas. Propulsion force: over 60 g (time average, rocket propelled minutes) +  $\alpha$  (EHD promoted amount) or more. The weight was around 28 g. The height of the device was 21.5cm. The thrust of the device with connecting the electrostatic and EHD propulsion unit increased around twice as much as that without the device.

Thrust force of 670 G (185 N = 18.9 kg) will be instantaneously generated, which was obtained by numerical calculation. Power supply: As an example, 20 kV is supplied to the system from the high voltage generation circuit. Voltage was amplified inside by fire and boosted to close to 200 kV.

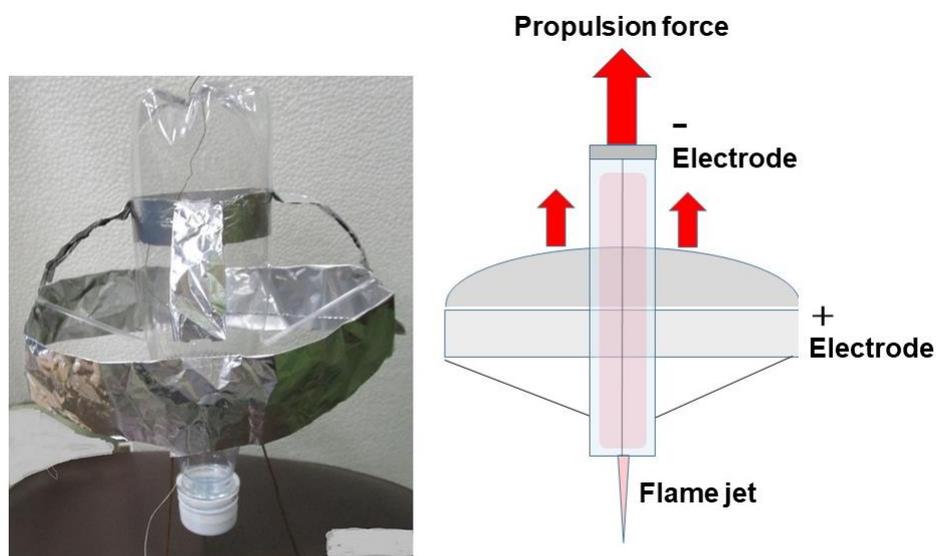


Fig.2. Experiment of propulsion for an example.

### 3.Future objects

It is obvious from this experiment that rocket propulsion such as pulse detonation engine and pulse jet, which has been studied in the past and can repeat combustion should be applicable to

this system. Larger weakly ionized plasma column in a larger cylinder is prospected.

### References

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