How My Speed Rocket Can Propel Itself in a Vacuum

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THE plan of Professor Goddard to shoot a small model of a high speed moon rocket within the next few weeks, as described in the April issue of POPULAR SCIENCE MONTHLY, called forth this question from many of our readers:

"How is it possible, as Professor Goddard proposes, for the rocket to propel itself by successive charges exploding in space? Since the space beyond the earth's atmosphere is practically a vacuum, what is there for the explosions, or expelled gases, to push against?"

We put this question to Professor Goddard himself, and he willingly prepared for our readers the following scientific explanation of how he believes his rocket will be able to propel itself in a vacuum.—THE EDITOR.

IN DISCUSSING the high-altitude rocket, there is not much question as to the long ranges possible, if a high velocity of the expelled gases is had with a rocket consisting chiefly of propellant material. There is, however, much criticism of the idea of the rocket propelling itself at a height where there is practically a perfect vacuum, it being maintained that there will be "nothing for the explosions, or expelled gases, to push against."

Contrary to common supposition, however, the explosions have a greater effect in a vacuum than in the air. In fact, if the air were very much compressed, the explosions, instead of giving strong propulsion, would have no effect whatever.

To see this, it must be realized that what pushes the rocket forward is the *gas that is shot back toward the rear*. Thus if a boy on roller skates throws some weights backward, he will be pushed forward by the reaction, as shown in Fig. 1. The faster he throws the weights, the faster he will be pushed forward. In a vacuum, the gases from the rocket will escape at a high speed, and the rocket therefore will continue to be kicked forward by the reaction.

EVERY one knows that a blank cartridge, fired in a revolver, produces a kick of the revolver; and the apparatus shown in Fig. 2, in which a blank cartridge is fired in a revolver free to turn about an axis, shows that the kick occurs also in a vacuum.

Fig. 1

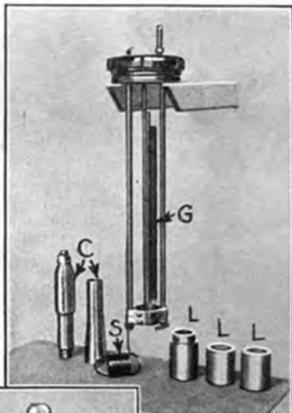

Fig. 3

Fig. 4

Fig. 2

On the other hand, if a blank cartridge could be fired in a tank containing air under a pressure so great that no gas could escape, then there would be no motion of escaping gases to give a kick to the revolver.

Ask any engineer if he would discard the condenser on his engine, in which steam exhausts into a partial vacuum, and replace it by a tank under pressure. He will tell you that if there were sufficient pressure in the tank into which the exhaust passes, it would stop the engine. The same principle applies to the rocket.

IN ORDER to test this point, a rocket chamber was fired in a tank pumped down to but 1/1500 normal atmospheric pressure. The chamber *C*, shown taken apart in Fig. 3, was weighed down by lead jackets *L*, and hung by a spiral spring *S*, as in Fig. 4. When the gases were fired downward, the recoil kicked the chamber upward, and the rise was registered by a scratch on a strip of smoked glass, *G*. The apparatus shown in Fig. 5 has been widely illustrated under various titles, but it simply is the device used in measuring the reaction in a vacuum.

The gases were prevented from rebounding by being shot downward into a tubular tank, Fig. 5, in which they circled around and around, being gradually slowed down by friction, with no possibility of their rebounding. Another, larger tank also was used, in which the gas was shot downward into a coil of wire fencing, which prevented rebound of the gas.

Fig. 5

THE results of 50 tests proved that there is *20 per cent greater lifting force* of a rocket in a vacuum than in air at ordinary pressure. This proof of reaction in a vacuum is but one of a number of matters that have been settled experimentally, and that will lead to rather startling results.

Can you imagine two vast flaming balls—one of them 8,000,000 times our earth in volume—hurtling about each other in a 173,000,000-mile path every two weeks! Read about this wonder of the skies in next month's issue.