

The Science of the Republic Series

This essay serves to explain the differences between current technology and technology as it's used in the Republic Series of books. It principally serves as a description suitable to ensure narrative continuity, not as a complete description of the technology.

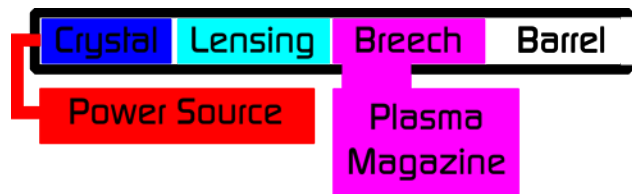
In the Republic Series, in general, science works in a fairly realistic manner. There are a few differences, however from current technology, one completely fanciful, one very speculative and a few reasonable extensions of current knowledge.

Tmetic Weaponry

Essentially tmetics are electro-magnetic beam weapons, much like lasers, though they operate on a broader spectrum of frequencies. In the books, power is supplied electrically to a capacitor which then discharges through a crystal, the crystal producing the tmetic beam. The beam is steered by, usually, a barrel, made of a different crystal, acting like a lens. It is also possible to produce a rapidly steerable beam using a phased array of emitters mounted on a flat plate.

Tmetics with barrels mounted may also deploy a plasma slug. This is a chemical suspension, loaded into the barrel ahead of the lens, which is turned to plasma by the tmetic energy hitting it. The plasma is formed sequentially, from the back to the front, and from the middle to the edges. This process causes acceleration, similar to a rocket launch and maintains the integrity of the slug until after it's left the barrel. By then the reaction is irreversible, the entire slug will convert to plasma. The slug continues to accelerate until all of the slug is plasma and the

chemical nature is highly cohesive, so the slug remains a single unit through short range flight. Its high temperature causes massive radiative heat loss in vacuum so it's next to useless in space, but in atmosphere, over short distances, it operates very effectively.



The above diagram shows a tmetic schematic with a plasma capability. The barrel is required to maintain the integrity of the plasma slug as it is ignited and accelerated. In general, therefore, tmetics with plasma enhancement have longer barrels mounted, and the more important the plasma capability the longer the barrel tends to become.

Capacitance Shielding

To provide defence against tmetics the outer surface of a protected body can be fitted with capacitance shielding. This is made of three components.

1. Throughout the hull is a mesh of superconducting fibres, which can dissipate tmetic energy at relativistic speeds.
2. The energy is dumped into a capacitance bank, to store it.
3. The capacitance bank is depleted using a heat exchanger or latent heat tank.

Capacitance shielding only operates until its capacitors are full, and the rate at which they

can empty is highly variable. In space, dumping capacitance heat is a serious challenge, so tanks of water are carried that can be vaporised into vacuum to discharge the energy. In atmosphere a conventional heat exchanger works, so ground vehicles tend to have heat exchangers, spaceships tend to have latent heat tanks.

Absorbent Armour

Most absorbent armour is made of multiple layers of complex construction. Typically they make use of 'hard' layers, composed mainly of aluminium carbide and silicon carbides, interspersed with 'tough' layers of tungsten-titanium alloys and more exotic metals.

Power Generation

Overwhelmingly power is generated using small, sealed, fusion reactors. The most common form of the fusion is helium-lithium fusion, producing abundant energy with fairly common elements as fuel.

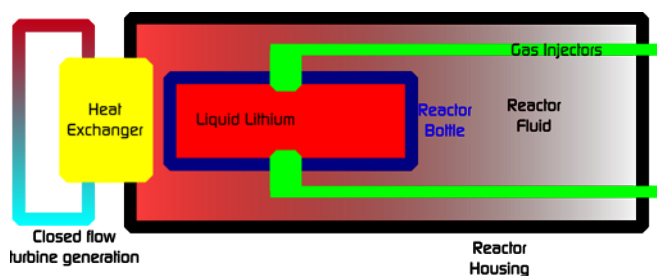
The fusion is conducted in a liquid chamber, made of a complex mixture of materials but mainly liquid lithium. Bubbles of helium are introduced under extremely high pressure and then permitted to collapse, causing cavitation. This cavitation is at a temperature sufficient to cause fusion, and the reactor bottle becomes extremely hot, therefore useful as an electricity generator, either by bimetal temperature gradient, or by simple fluid expansion, such as turbine propulsion.

These reactors are provided as sealed units, are not usually susceptible to maintenance, and are discarded when depleted. Engineers can, if they choose, replenish the components of a reactor but tuning the cavitation is a highly specialised task, so such a reactor might need

some manual intervention to initiate fusion or to maintain it, if the cycle drops and the bottle falls cold.

Control of the reaction is maintained by controlling the divisions between the parts of the reaction bottle where the helium injectors are located.

Cavitation is managed by introducing the Helium, mixed with a gas that reacts with the lithium, into the edge of the reactor bottle. The gas bubble moves inwards (in a gravitational sense) as the gas bubble contents react with the helium reducing its size. The inward movement is achieved by spinning the bottle, generating an artificial 'down' at the edge so the bubble moves 'up' into the middle of the vessel.



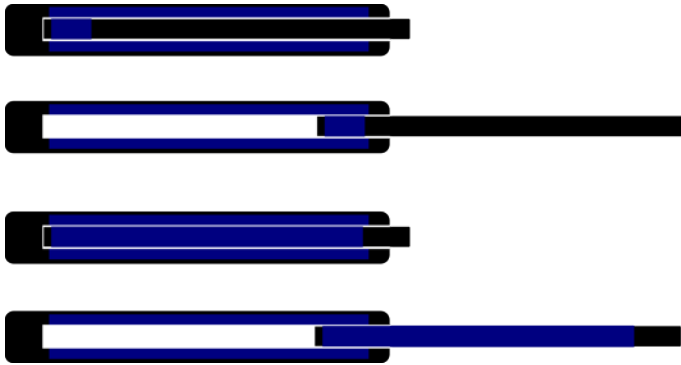
At a critical size the bubble collapses, at which point it's almost entirely helium, causing a massive temperature and pressure spike and fusing the helium with the surrounding lithium.

Electric Controls

In general, electric motors are merely minor technical improvements over current examples. The addition of cheap superconductors that operate at wide temperature changes makes motors light and powerful.

There are also powerful electromagnetic rams that operate on the coil-principle, like a solenoid. There are generally two types, those that provide steady pressure over the extension range and those that provide a decreasing force

as they extend. The first type are often used for hatch actuators, the second type work like springs, with infinitely adaptable tension, but obeying any variant of Hooke's Law that is required. The spring type differ in that the second coil is longer, so as the unit extends there is less overlapping surface.



The top two diagrams show a constant-force EM ram, the lower two show a variable force ram. The blue areas show the locations of the superconducting coils. In the lower example the force decreases as the ram extends because there is steadily decreasing overlap between the two sets of blue coils as the ram moves.

Inertial Damping

In the Republic series there is a truly exotic piece of science fiction. A special device called an inertial damper can be used to reduce the effective mass of itself and its surroundings to 0.

The damper consists of a superconductor, wrapped around a non-conductive block of material. An intense magnetic field, created around the non-conductor makes its effective inertia drop to 0, or any other value within the range of possibilities offered by the damper. Further, the damping extends to some distance from the damper itself. The main limitation of the damper is set by the maximum mass it can damp, not by the radius over which it can extend its effect.

The mechanism of action that leads to this damping effect is quite complicated, but in essence it works on the following process:

All components of normal matter can be seen as perturbations in the Dirac Sea of positrons and their fields. As with the Scharnhorst Effect, the Dirac Sea can be reduced in intensity if the larger positron perturbations are eliminated, by rendering the physical space between the plates too small for the perturbations, thus the speed of light between the plates is much higher. The inertia damper effects the Dirac Sea in the same way, eliminating almost all the positronic perturbations, which in turn eliminates inertia, raises the effective speed of light to essentially infinite speeds and protects the contents of the field in an inertial neutral space.

The most common use for this technology is as the 'jump mass' in a starship. As the inertia and mass reach 0 there is a chance to accelerate the ship infinitely fast for any amount of accelerative force produced by the drives. This allows ships to travel faster than light, in fact, much faster. There is no theoretical limit to the speeds attainable, though the faster the ship travels the less accurate it will be at the task of accurately dropping out of FTL at the desired location. The damping for these ships extends beyond the hull somewhat, ensuring that the ship cannot be harmed by an encounter with small masses, but the ship would still be destroyed if it hit a star, or planet, obviously.

The easiest way to explain the effect is to imagine that the ship projects a field around it in which the speed of light might be millions of times higher than in normal space. In such a field acceleration, top speed and inertia have completely different values.

The damping affects the entire ship, including everything within it, so the crew experience no acceleration-sensation if damping is fully engaged.

Kinetic weapons can have a damping field allowing them to accelerate tremendously quickly, then flick the damping into reverse, massively increasing the effective mass of the kinetic projectile before impact.

The design of these exotic components is not disclosed during the series, however there are elements to the design that have an effect on the use and maintenance of these systems. In particular the superconducting shell is extremely sensitive to damage and has to be protected from any threats. Further the actual unit itself is only a part of the operational requirement for a suitable damper. Associated with it is a complex telemetry system that can monitor the operational state of the drive.

While mass damping on ships is well-established technology the system has also been used in a number of other areas, with notably less success.

It can be used to form a component of transport pallets, intending to make the loads carried on them more portable. In this context it is generally operable but wildly uneconomical.

It has also been used to provide individual dampers, in reverse, attached to such things as armour plates, most notably on the late-model Emperor tanks. While expensive, this allows the overall armour density to be massively increased in combat, while letting them be much lighter for transport. In practice the gigantic acceleration difference between air-molecules adjacent to the armour, compared with those further away, proves to be problematic, making the vehicle noisy, impossible to camouflage effectively and unpleasant to be near.

CONAN Drives

The CONAN drive is a core part of the technology of the universe. The acronym stands

for 'Combined Nuclear and Nuclear' and refers to the installation of two independent nuclear engines. One, more powerful, provides for main thrust by using a nuclear reactor to vaporise fuel substances and accelerate them through a conventional rocket. In this capacity almost anything can work as fuel.

The second drive is an extremely low power unit, emitting streams of particles down to a single molecule in both width and duration. It has, however, a small inertial compensator built into the engine, so it can tune the effective mass of the exhaust relative to the inertial compensation of the entire ship. Such a system allows the ship's engines to operate even in an environment where the inertia within the ship is set to 0.

Most CONAN drives operate on a three-process acceleration arrangement. The fuel, preferentially, contains potential chemical energy, that is added to the fuel expansion caused by the heat of the nuclear reactor and is then further accelerated by using a superconducting toroidal collar that acts upon the ionic products of the fuel burn.

Closed-System Motors

In a closed system motor, one where there is not intended to be an exhaust, the energy is harvested using a turbine system. The design of the turbines would be instantly recognisable to any engineer. In general the rotor-stator system is used and the pressure is delivered inline. Normally the rotors are on a single spindle, rotational speeds managed by using duct-profiling.