

Capacitor Discharge Technology

The next leap in airgun technology. It is unusual for a new innovation to revolutionise an industry, but this technology is threatening to do that, and even more.

Airguns have been progressing by leaps and bounds over recent years. Now electronics has caught up with pneumatic airgun technology. Everything is about to change.

History of CDT Development

Capacitive Discharge Technology, or CDT as it is known, is a disarmingly simple idea, but is difficult and challenging to make-work. It was invented and developed in the 1980's by Stephen Harper (Harper Classic Guns) and David Snook, who provided the



Above: Harper Classic Wolf

necessary electronic expertise.

At that time a new generation of transistors were emerging that were to make the whole technology practical. Steve designed the first prototype of the Harper Classic Wolf. It is difficult to imagine the long weekends of frustration worked in an electronics laboratory, experimenting with different pressures, timings, voltages and valve sizes trying to get the principle to work.

The first stage of development was getting the pellet out of the barrel! You can imagine the joy when magically, it all seemed to fall together and Steve and Dave reduced a telephone directory into shreds using just one fill of air.

Even then Steve and Dave realised that they had something very special. CDT was found to be extremely efficient, reliable and provided a degree of self-regulation, all without any effort required to cock the gun. They were getting

typically 30 to 40 full power shots out of a relatively small pistol. A diminutive PP3 battery produced enough power for thousands of shots.

Steve went on to develop the Wolf air pistol and patent the technology, the UK patent was granted in 1996.

CDT Comes of Age

While the Wolf sold steadily, it only achieved small volumes, and a select band of fans. One early Wolf user reported that he got 10,000 (ten thousand) shots from one battery! The technology was way ahead of its time. Some manufacturers took interest in the technology, but Steve was reluctant to take any offers until very

recently.

Daystate had been experimenting with an electronic trigger release for some years. They were quick to realise the advantage of using a switch to provide a

precision trigger, where creep and other problems simply did not exist.

Daystate's technology was different from CDT; this technology had been used before in other match grade pistols and guns. The switch and electronics were used to operate a sear, releasing a conventional spring and weight striker.

Daystate are now going to use CDT in their new generation of guns, and is guaranteed to change the airgun industry forever. Bold words, but please read on.

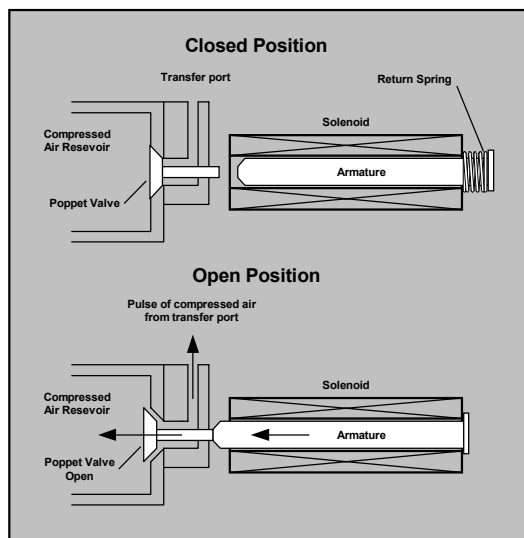
CDT, What Is It and How Does It Work?

As Capacitor Discharge Technology suggests, it involves charging a capacitor to a preset level, then discharging it, in a controlled manner into a magnetic solenoid. The armature of the solenoid is then used to strike open the poppet valve of a pneumatic system and release a metered pulse of air.

As has been said earlier, it sounds simple, there are few moving parts and the principle is simplicity itself. However it was quickly found that the valve, transfer port, armature stroke,

solenoid size and actuating current waveform were heavily inter-dependant and needed careful design. Steve had to design and make dozens of valves before a formula that worked was found.

The first electronic circuit that was developed was crude but effective, its purpose was to charge a capacitor up to a certain voltage then discharge it into the solenoid for a set period of time to actuate the armature and open the valve when the trigger is



Above: Diagram of CDT release mechanism

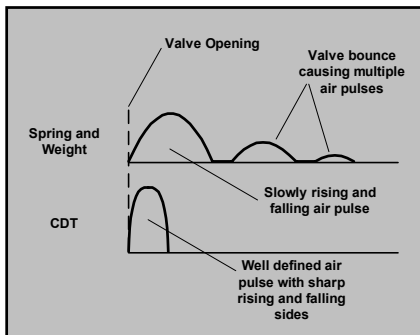
pressed.

The lock time, that is the time from the trigger was pulled to when the pellet left the barrel, was found to be incredibly short. This was attributed to the solenoid action being able to open the valve in a very short time, and when the current was switched off, the valve closed very quickly in a controlled manner.

If a conventional spring and weight knock-open valve system is badly designed, then bounce can occur causing air wastage and air turbulence when the pellet is leaving the barrel.

In any event the conventional system has difficulty competing with CDT when it comes to the shape of the air pulse.

It surprised Steve and Dave on how short the actuating pulse of current was needed for efficient and effective valve operation. A distinct difference can be heard when dry firing a conventional gun alongside a CDT gun, the conventional gun produces a low frequency “chuff”, when the CDT gun “cracks”. The difference is even more astounding when ammunition is used; the CDT gun is far quieter, indicating its efficiency.



Above: Differences between CDT and conventional valve technology

Electronic control of the solenoid also gives the ability to easily control the power of the gun, in many respects the controllability of the CDT system is one of the most intriguing and useful qualities the system has and is yet to be fully exploited.

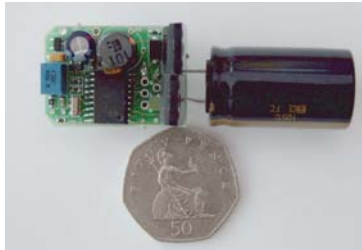
Current CDT Developments

Things have come a long way since the first designs. Valves and solenoids have been improved

and the electronic charging and control circuit is now controlled by a microprocessor.

Microprocessor control has been found to be necessary to get the kind of accuracy and programmability to suit different applications needed.

The control board delivers precision voltage and time duration



Above: Microprocessor CDT control board

pulses to the solenoid that can be varied between the requirements of a plinking pistol to an FAC rated hunting rifle.

CDT Advantages

More shots per charge:

The valve is far more efficient because of the controlled fast opening and closing of the poppet valve. The magnetically fast valve opening also allows the pellet to accelerate quickly without waiting for a wasteful build up of pressure.

Typically a doubling of shots can be expected with a well-designed CDT and valve set-up.

Better accuracy:

Because there is less air used for a given amount of muzzle energy there is less air blast after the pellet has left the barrel. This results in less air turbulence and tighter groups. CDT also delivers extremely quick lock times, with magnetically fast valve opening and rapid pellet acceleration.

Superior trigger:

Some of the best match triggers available use a switch and an electrical circuit to release a sear. CDT can use any switch the manufacturer desires, where creep is a thing of the past.

Greater reliability:

There are fewer moving parts and little to wear out. Lubrication is for life and routine maintenance is changing the battery.

Nothing to cock:

No effort is required to cock the action. This leaves less for the marksman to do and concentrate on the next shot.

Quieter:

CDT is quieter because of its efficiency and less air wastage. This can be used to advantage when hunting and is most welcome when used for indoor target shooting.

Safer:

Because CDT is electronic it can be turned on and off with ease. Daystate has gone one step further and provide a security lock, where the gun is inactive until it is unlocked with a key, very much like a car's ignition switch. The system is also more difficult to interfere with to produce illegal muzzle velocities. The processor can be “locked” to prevent unauthorised tampering.

Controllable:

Altering the voltage and pulse duration can control muzzle energy. This can be used to regulate the muzzle velocity and allow the user to select various power settings. This is where CDT gets even more interesting because it can potentially eliminate mechanical regulators, but it will need more development work to reach this goal.

Self-Regulating:

CDT can be arranged to provide a degree of self-regulation. The characteristics of the solenoid and valve make the poppet valve return faster when the pressure is higher, this “pinch-off” effect is reduced when the pressure lowers and allows the air pulse to lengthen. So when the air pressure is high, the air pulse is short and when the pressure is lower the air pulse is longer, maintaining a relatively constant muzzle energy curve. While this is not as accurate as a pressure-regulated gun, it flattens the power curve considerably. Daystate are using a regulator in conjunction with CDT, with the shot to shot power variation dependant only on the consistency of the ammunition used.

Long Battery Life:

Surprisingly, when you consider all the pneumatic energy that CDT can deliver, even a PP3 9volt battery will provide power for thousands of shots at FAC power levels.