THE ENERDRIVE SYSTEM

super CAPACITIVE RETURN

U.S.A. Patent 5,278,454
International Patents Pending

nep incorporated super capacitors to provide a means of making its line of actuators move to a customer selected position in the event of a power failure. This task was traditionally accomplished by means of mechanical springs. Having the actuator return to a specific position is required by industries using these types of products on air dampers, as well as chilled and hot water valves. The reasoning behind this requirement is that if power fails, the device should go to the selected "safe" position to prevent harm or damage to equipment, products, livestock and people due to environmental factors.

In cold weather environments, problems such as air-conditioner coil freeze-up can occur if the outside air damper does not close. In water lines, the flow valve should move to the fully open position during a power failure. This allows water to flow in the pipes and helps prevent rupture of the pipes in cold weather climates due to the water freezing.

Some environments must be continually cooled because of internal heat generation. In these environments there may be a requirement that the outside air dampers return to the fully open position to reduce the heat buildup inside the area being cooled. Examples of these types of environments include factories and office buildings during periods of warm or hot weather. Another example where heat built-up can be excessive is in controlled environment animal pens such as found in the egg production areas on modern poultry farms and in the indoor pen areas on modern pig farms. Enough heat is generated by the relatively tightly packed animals themselves and the farm equipment in the area to raise the temperature enough to harm or kill many of the animals.

Advantages of Super Capacititive Return Instead of Springs

During an actuator's duty cycle, a motor is used to drive a damper or a valve to a desired position. In an actuator which uses a spring to return the damper or valve to the "safe" position in case of a power failure, the motor must also wind up the spring to create the return force. This takes energy. The motor must overcome both the force required to drive the damper or valve as well as the force exerted by the spring. By eliminating springs, the additional force (power) requirement to wind the spring is eliminated. This allows us to increase unit efficiency and use less power, use either a smaller motor in a unit or to use the same motor and have a significantly higher drive safety factor and motor life expectancy.

Another advantage of using the super capacitors instead of springs is overall unit life. Springs used to return a damper or valve to a "safe" position are relatively highly loaded and have a high internal stress. This causes the springs to either fatigue or break after "X" cycles or to lose power by taking a "set". Springs can be designed to have a significantly lower stress and a longer life cycle but cost factors must be considered very closely. To save money, Designers try to make the time factor or cycle factor

beyond the estimated life of a unit. Sometimes they are not successful and a unit fails to operate properly.

One of **nep**'s major competitors guarantees a unit similar to the one we had on test for only 60,000 cycles. We have concluded that this cycle limit was based primarily on the estimated life cycle of the springs the competitor uses in their unit. As will be noted below, we tested the super capacitors in a unit for over 800,000 cycles before testing was ended. The capacitors showed no notable signs of degradation at the completion of the testing. During our test cycle we did have to replace a gear set in a unit after over 330,000 cycles to keep the capacitor test going. 330,000 cycles is still over six times the guaranteed life expectancy of the major competitor's equivalent unit.

Super capacitors are inherently safe in that they present no danger to anyone during the manufacturing process, the installation of the product in the field or during operation of the product. For example, inverting the polarity during manufacture or abusing the super capacitors by overcharging with a voltage in excess of 4 times the rated voltage of the capacitor will, at worst, result in the internal malfunction of the capacitor with no external physical manifestation. This is in contrast to a standard capacitor which would more than likely explode under these same conditions. There is no threat of electrocution from the super capacitors within **the enerdrive system** as the power is so low.

Super capacitors are environmentally safe. The materials used in construction, i.e. activated carbon, conductive rubber, a weak acid and an aluminium and plastic enclosure are nontoxic and recyclable. Life expectancy, as estimated by ***NEC***, is in excess of 50 years under normal environmental conditions which is more than sufficient for the life of the actuator.

Cycle testing by both ***NEC***, the supercapacitor manufacturer, and **nep** have been conducted at temperature extremes from 121°C to -35°C respectively. No ill effects were remarked and the actuators continued to function normally, cycling the enerdrive system on and off.

Due to the simplicity of **the enerdrive system**, **nep** has been able to incorporate it in selected models of the baby blue at 5.6 Nm./50 in.lb., the true blue at 20 Nm./180 in.lb. and the royal blue at 40 Nm./360 in.lb. for either digital or analog control signal and either 24 VAC or line voltage supply. This is the widest range of fail safe damper or valve actuators offered by any manufacturer in the world.

Lastly, although designed as a fail safe positioner in the event of mains failure, **the enerdrive system** may also be used as the means of closure in two position applications.

Test Data

Testing commenced in March 1992 using two different mechanical fixtures to accumulate data.

FIXTURE #1 consists of three bbt1060 actuators mounted atop 3/4" 2-way ball valves with an average torque of 35 in.lb. each (70% of rated load). The actuators are driven open and the drive signal is removed allowing the motor to return to its closed position.

This cycle continues at the minimum timing required to drive the actuator to both ends. This procedure provides the maximum cycling of the charge/discharge cycle producing the highest number of cycles over a given time period.

This test was repeated in excess of 800,000 cycles before the test was halted. No sign of capacitor failure was evident.

FIXTURE#2 applied a 50 in.lb. load (100% of rated load) to the actuator. This was accomplished by raising a 9.1 pound load through a 11 inch diameter wheel attached to the output shaft of the actuator, a bbt1060, *Fig. i.*

The weight was allowed to fall. When the end stop was reached and verified via a feedback position indicator internal to the actuator, the external power was removed. This allowed the super capacitors to provide the power to raise the weight back to its full up position.

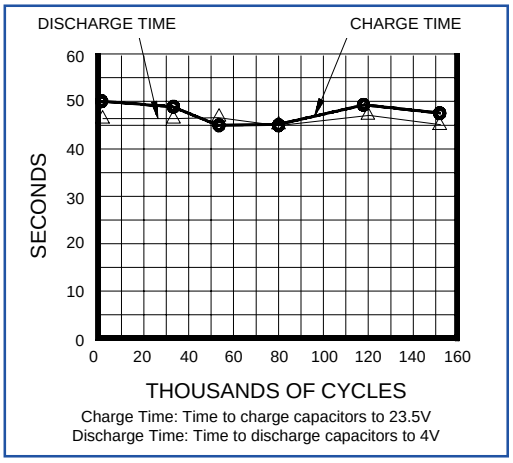

Fig. ii Capacitor Charge/Raise Times

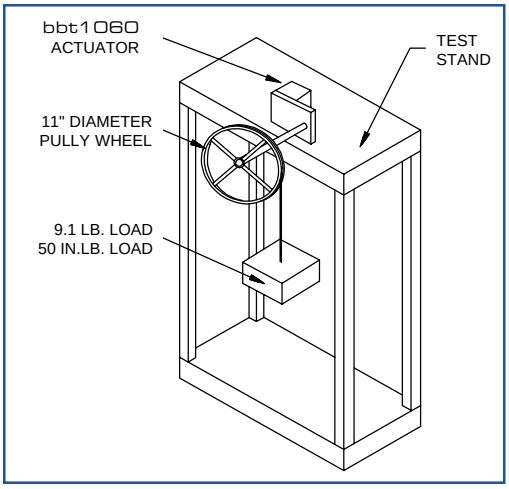

Fig. i Test Fixture #2

Again, the position was monitored through the feedback system. The charge was monitored directly on the capacitors. When they reached 3.0 volts, the power was reapplied to restart the cycle. This test monitored full charge, discharge, and operating characteristics of the capacitors, *Fig. ii*.. The test ran the full range of expected operating conditions of the actuator.

This test was repeated over 175, 000 cycles. No signs of capacitor failure were evident.

Summary

Standard production motor driven actuator assemblies were modified to use super capacitors to drive a shaft to a "safe" position incase of power failure instead of the springs the actuator normally used to accomplish the function.

TEST ONE

- Units with the super capacitors instead of springs were tested at 70% of its rated load.

- The test units were inspected at regular intervals for signs of failure.

- At 333,415 cycles a unit developed a gear motor problem. The gear motor was replaced and the test was continued.

Testing was stopped at over 800,000 cycles - the units and capacitors still met specifications.

TEST TWO

- A unit with super capacitors instead of springs was tested at 100% of rated load.

- The unit was inspected at regular intervals for signs of failure.

- Testing was stopped at over 175,000 cycles - the unit and the capacitors still met specifications.

THE ENERDRIVE SYSTEM

national environmental products ltd., inc.
ft. lauderdale, fl usa

PRINTED IN THE USA

NEP0696