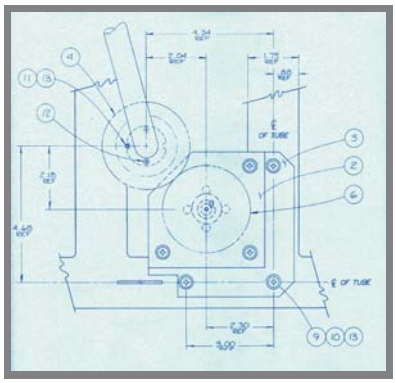
How the ERGYS Works: An Automobile Analogy

When discussing the technical details of the ERGYS with riders and clinicians, our favorite analogy at Therapeutic Alliances is one of a six-cylinder automobile with the cruise control set at 50 miles per hour. In the case of the ERGYS, the analog of miles per hour is revolutions per minute (RPM) of pedaling, and the 6 cylinders of the car can be thought of as the quadriceps, hamstrings, and gluteal muscles of the rider's legs. It follows in our analogy that the ERGYS "spark plugs" are the electrodes placed over the motor nerves of the muscles. In an automobile, the source of power is the combustion of a mixture of air and gasoline. The ERGYS equivalent of combustion is the electrochemical reaction that takes place when the muscle nerve is electrically stimulated via a surface electrode.



The ERGYS sequences its electrical stimulus much like an automobile fires its spark plugs. The automobile sequence is timed so that the linear travel of the pistons in the cylinders is smoothly converted to the circular motion of the drive train shaft, and, ultimately, to the rotation of the tires. Each piston is restrained by a cylinder wall so that the movement of the piston is restricted to a direction that will contribute to the turning of the crank shaft. With the ERGYS, the Leg Restraints can be thought of as the cylinder walls. The Leg Restraints help to ensure that the force generated by the muscle contractions is transferred to the pedal crank and not lost through a "wobbling" of the legs at the hip and knee joints. As with any piston-cylinder combination, the truer the motion, the more efficient the transfer of power.

Our bodies tend to naturally convert muscle contractions into the circular motion necessary to accomplish tasks such as pedaling a bicycle. The ERGYS computer sequences the contractions of the quadriceps, hamstrings, and gluteal muscles in an order that allows for the hip, knee, and ankle joints to combine to create the repetitive circular motion of pedaling.

Sensors in the ERGYS perform a variety of measurements that govern a session. One sensor is used to track the angular position of the pedal crank, and hence the position of the legs. This position is used by the ERGYS computer to select the muscle to be stimulated. The intensity of the stimulus is dictated by the pedaling rate, which the ERGYS computes by measuring the change in pedal position over a fixed unit of time. Rates below 50 RPM will call for the ERGYS to increase the stimulus level. Conversely, rates above 50 RPM will cause the ERGYS to lower the stimulus level. In this way, the "closed-loop" control of the ERGYS is similar to the cruise control of a car. The ERGYS will continuously raise and lower the stimulus intensity to keep the rider at 50 RPM, much like a cruise control will meter the flow of gasoline to maintain a preset speed.

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