IMG-89-001 - ULTRASOUND -Computer Controlled Positive Displacement Pump for Physiological Blood Flow Simulation

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Technology description

Description

This invention relates to a computer-controlled physiological flow simulator for use in the study of vascular hemodynamics and the calibration of clinical imaging systems used to measure blood flow (Doppler Ultrasound, Magnetic Resonance Angiography (MRA) and X-ray Radiography). The simulator employs a pump, referred to as the UHDC Flow System, capable of producing, and reproducing, steady, sinusoidal and physiological pulsatile flows in vitro, such as those that are found in femoral and carotid arteries. Blood flow simulation systems are of clinical interest as they contribute to our understanding of the genesis, progression, diagnosis, and treatment of cardiovascular disease and stroke. Although other blood flow simulation systems exist, the UHDC Flow System provides a steady flow with no evidence of gas bubbles, providing a significant advantage over previous designs.
The UHDC Flow System is comprised of two horizontally opposed pistons driven in transparent, plastic cylinders by a computer controlled micro-steeping motor. A four-way valve, also under computer control, determines the direction of the fluid flow. The valve permits the interchange of outlet and inlet paths when the piston reaches the end of its travel. This allows the pump to refill one cylinder while forcing the fluid out of the other. This scheme allows for nearly 100% duty cycle. The systems open loop performance accommodates a wide range of flow rates and allows for the reproduction of pulsatile wavelengths that are stable over long periods of time.
Cardiovascular disease is the number one killer in western societies, affecting over 61.8 million Americans, and generating direct costs for diagnosis and treatment of $209.3 billion annually worldwide. The dependence on clinical imaging systems to measure blood flow, in health care centers, defines the need for devices to calibrate these instruments. In addition to validating instruments used in the diagnosis of cardiovascular disease, researchers continue to focus on understanding blood flow and related physical forces that interact with the heart and vascular tissue. As more of the human population reaches an age of increased risk of cardiovascular disease, the need for tools to validate clinical imaging instruments and assist with research into this epidemic will continue to rise.

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