# engineering sciences

AUTO SAFETY

## Power steering: Feedback delay hazardous

Safety in driving any vehicle, especially in an emergency, is decreased by power steering, concludes psychologist Karl U. Smith from his studies at the University of Wisconsin's Behavorial Cybernetics Laboratory. Smith's research has centered on human reaction to various steering and tracking mechanisms and their effects on body coordination. He notes that in addition to auto momentum and the dynamics of the steering mechanism, the filter system in power steering causes a delay of from 0.2 to 0.4 second between the time the driver turns the steering wheel and the auto's turning response.

Says Smith: "The newest theories see the automobile as an exoskeletonal machine—a continuation of the driver who expects it to react at the same speed as his own skeleton. In my view, this feedback delay is the major cause of accidents even when alcohol, inexperience or carelessness are also factors." The delay, he asserts, damages driver coordination of hand and eye movement such that the mind then fails to predict the outcome of his actions. He further suggests that drivers never fully adjust to this delay factor.

AUTO SAFETY

## Braking: Pedal-force levels too high

In a panic stop, a force of up to 200 pounds may be required after brake fade. In tests with 105 adult female volunteers, National Bureau of Standards researchers found few who could exert this sustained pedal pressure required by present automotive standards to accomplish an emergency halt. Moreover, in one late model car, 20 percent failed to exceed a sustained force of 135 pounds.

Test subjects were considered typical, ranging from 59 to 69 inches in height, 102 to 206 pounds in weight and 18 to 62 years in age. Lapbelts were used on the adjustable seats.

The NBS engineers conclude that, although power brakes would readily assist weaker drivers, automotive controls must be designed to meet the needs of all vehicle operators. They also note that failure of the test subjects to exert the maximum force allowed by today's standards appears unrelated to their height, weight or age.

LABORATORY FURNACE

## Providing rapid intense heat

Scientists requiring high temperatures for their laboratory investigations often must face the inconvenience of a remotely located electric furnace, because of its unwieldly size and the need for high-power electrical lines. This problem may be solved by an experimental furnace developed at Union Carbide's Tarrytown [N.Y.] Technical Center.

The 15-pound prototype is a cube eight inches on a side, and has an inner chamber six inches on a side. It attains a stabilized temperature of 1,700 degrees C. in only five minutes, developers claim. Using conventional construction to obtain the same size inner chamber, they estimate the furnace would occupy 64 cubic feet, weigh 900 pounds and need 8 hours to reach 1,600 degrees C.

The design advance results from the firm's use of new materials for the heating elements and the furnace insulation. The six nonmetallic resistance-heating elements are of molybdenum disilicide (Kanthal Super 33), developed by Kanthal Corp., Bethel, Conn. Operated from standard electrical outlets, the elements have long life, no watt-loading limitation and are not affected by thermal shock, Kanthal claims. The Union Carbide fibrous zirconia block insulation, called Zircar, is only three-fourth inch thick, yet it controls the furnace shell temperature to a maximum of 125 degrees C.

FLUID DYNAMICS

## Water impact effects differ

The destructive effects of high velocity fluids on solid materials are well–known, but the processes of eroding and cutting by water impact are not well understood by scientists. It is believed, however, that the fuselage or wing erosion of an aircraft by raindrops and the intentional slicing of materials by means of a water jet represent different dynamic mechanisms.

To determine feasibility of using water as a cutting tool, researchers at the Gas Dynamics Laboratory of Canada's National Research Council in Ottawa have built a facility to supply water at 50,000 pounds per square inch to a 0.010-inch diameter nozzle. This, they report, will be increased to 100,000 pounds per square inch in time. A first practical application is the cutting of newsprint during its manufacture. The biggest problem is that power needs are excessive compared to more conventional cutting methods.

Meanwhile, scientists at Bell Aerospace Division of Textron in Buffalo have studied the anatomy of erosion of aluminum alloys by water droplets at impact velocities near 1,120 feet per second (Mach 1.0). They learned that on impact a water drop laterally sends out jets traveling up to 10 times faster. These strike microscopic surface irregularities that eventually crack at their bases and then become cavities. Direct impingement by successive droplets on the cavities creates shock waves that tend to compress the water into a "spear-like" central jet, boring a secondary pit. When the pits intersect, the tunneling effect further weakens the eroded material.

SURVEILLANCE RADAR

## Elevated by helicopter

Tactical forces must have early warning of enemy aircraft attacking at tree-top level. At best, because of the earth's curvature, a detection radar can acquire such craft at 10.5 miles or less—if there is no interference to the tracking beam from terrain or foliage. A reduction of just one degree from the angle on the radar beam cuts detection range to a mere half-mile. To solve this problem, the Air Force is now evaluating an L-band, two-dimensional scanning radar that is installed beneath a UH-1 helicopter.

Developed by Westinghouse Electric Corp., the rectangular antenna folds into the space between the landing skids for takeoff and landing, can be deployed or retracted in 30 seconds, and rotates slowly to scan a full 360 degrees at about one turn each seven seconds. The system includes an air-ground data link for communications and ground display.