engineering sciences

OPTICAL PYROMETRY

Speedy measurement of refractories

For thermal measurement of opaque materials above 1,000 degrees K., the most accurate noncontact method has been with optical pyrometers, which determine temperatures by measuring the intensity of light radiated by a hot object.

A defect in these machines has been that response time is limited to about one second. Recently, however, Leeds and Northrup Co. engineer G. M. Foley and a National Bureau of Standards team jointly developed a high-speed pyrometer of at least equal accuracy as a means for measuring the thermophysical properties of refractory metals by pulse methods. They report that at 2,000 degrees K., the technique offers a precision ranging from 0.2 degree K. with a 0.8 millisecond response time to 0.01 degree K. for 1 second or longer.

The developers employed an electron multiplier phototube alternately exposed at 0.2-millisecond intervals to light from both an unknown source and a calibrated reference lamp. Light from each is received through an optical train, including a disk shutter turning at 200 revolutions a second, at three intensity levels. The resultant pulses are processed and compared in a small computer twice per exposure, and averaged. Successive samples also are averaged to provide a greater degree of precision.

SEMICONDUCTOR LASER

Continuous output at room temperature

Bell Telephone Laboratories, always looking for a means for providing faster or higher capacity communications, may have found a way to achieve both. Two of its scientists, Izuo Hayashi and Morton Panish, have developed a solid-state laser that will operate continuously at ambient temperature from a power supply as small as a dry cell battery. Its coherent beam is in the infrared range, at about a wavelength of 8,500 angstroms. Until now current thresholds, or the point at which light amplification begins, and the resulting semiconductor temperatures were so high as to limit operation to brief pulses.

By employing a four-layered structure, the Bell engineers reduced the room-temperature threshold-current level to 2,700 amperes per square centimeter. In 1969, Bell had reported achieving a figure of 8,600 and engineers in the Soviet Union claimed thresholds as low as 4,300. Bell also discloses it has lowered the figure even further to 1,000 with experimental structures.

The new laser, a double heterostructure diode, employs four thin alternating layers of gallium aluminum arsenide and gallium arsenide. The layers are doped with germanium, silicon, tin and zinc. In operation at 30 percent above threshold, output at ambient temperature is 20 milliwatts, with a power efficiency of 1.5 to 2 percent.

FIRE RESEARCH

Intumescent coatings

Fire and munitions in an ammunition depot can be a fearsome pair; add the jet fuel of a Naval aircraft carrier and the experience can be devastating, because of the very short time before explosion temperatures are reached. To lengthen this critical time and thus improve the chances for removal of explosives or evacuation of personnel, Cornell Aeronautical Laboratory, Inc., conducted a preliminary study for the Army's Picatinney Arsenal in Dover, N.J., of the thermal protection offered by intumescent coatings. These are paints that tend to swell considerably when charred, forming an insulating layer.

Investigators D. E. Adams and W. R. Brown, in testing only 17 paints, found one that extended the explosion time interval from 1.25 minutes to nearly 4 minutes. Since there are hundreds of these proprietary commercial paints, promise is held for finding even better fire resistant coatings, they assert.

In the tests, jet-engine fuel in shallow pans was burned beneath 750-pound bombs having an explosion temperature of 400 degrees. The best coating was an unidentified clear varnish. When heated, the researchers say, it passed from an initial phosphoric acid-carbon stage to a decomposing ester, forming carbon, water and nonflammable gases. This led to formation of a thick carbon-foam layer.

HYPERSONIC TESTING

New MIRV wind tunnel

For what appears to be advance preparation for design testing of multiple independently targeted reentry vehicles (MIRV), the Navy discloses it is building a hypervelocity wind tunnel for use by 1972. Located at the Naval Ordnance Laboratory at White Oak, Md., the facility is intended for studies of reentry vehicles maneuvering at low altitude at speeds from Mach 10 to Mach 20. Its major element, a 72-foot diameter vacuum sphere, has been completed and successfully passed its first operational test last month, the Navy says.

PETROLEUM STORAGE

Undersea tank

A 500,000-barrel crude oil tank, sunk in 154 feet of water 60 miles offshore in the Persian Gulf, is proving to be a lower cost but fully satisfactory alternative to more conventional onshore methods of fuel storage. Identified as Khazzan Dubai 1, the structure holds oil, prior to transfer to seagoing tankers, from the Fateh field and is a facility of Dubai [shiekdom] Petroleum Co., a subsidiary of Continental Oil Co. Designed like an inverted funnel, its measurements are impressive: The large open end on the sea bottom is 250 feet in diameter; the narrow end rises upward some 205 feet overall, 55 feet of which is above sea level.

Because oil floats and the 30-foot diameter narrow end above water causes a pressure imbalance, the seawater is forced out of the tank as crude oil pours in. Reportedly, no troubles have been encountered during eight months of operation in meeting a specification limiting contamination by the salt water to 10 pounds of salt per 1,000 barrels of oil. Designed and built by Chicago Bridge and Iron Co., the tank saved several million dollars in storage and docking costs otherwise needed and saves tankers over 100 miles in round trips for loading.