CRYOGENIC news

Research news

LH_2 — a more efficient fuel for cars

Hydrogen is a more efficient fuel for automobiles than gasoline and a liquid hydrogen fuel system is a viable concept for a hydrogen-powered vehicle. These are the findings of a recently published report on the hydrogen car development project at the University of California, Los Angeles. The initial findings of this project, commissioned by the US Department of Transportation, were published last year in CRYOGENICS (Vol 14 No 8 (August 1974) p 472).

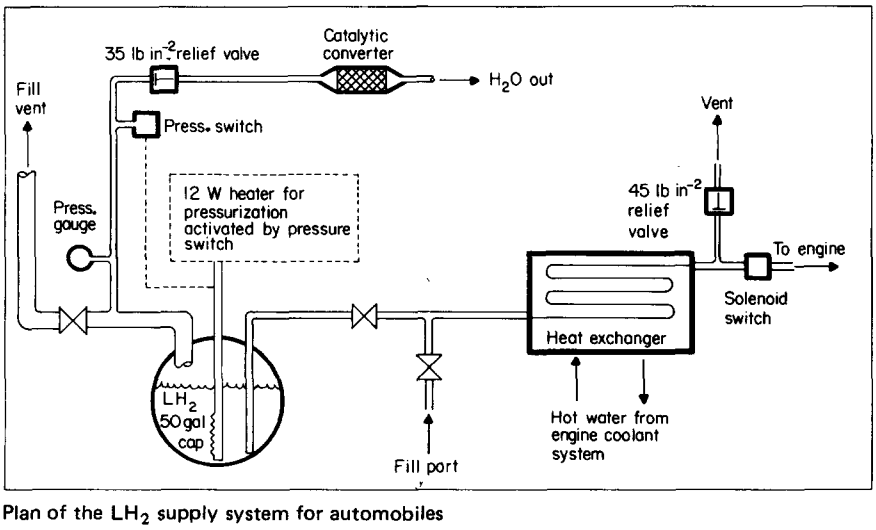
A 1973 Chevrolet V8 350 in^3 displacement engine was tested first with gasoline using the required pollution control devices and then after appropriate modifications with hydrogen. Thermal efficiencies and nitrogen oxide emissions were determined as functions of power output at various engine speeds. The results were fed to the simulator of the University of Wisconsin's project on increased fuel economy by use of energy management. This showed a fuel economy equivalent for a 2 000 lb vehicle with LH_2 to 25 miles per gallon of gasoline. Nitrogen oxide emissions were predicted to be less than 0.04 g per mile compared to the 1976/77 Federal standard of 0.4 g per mile.

Both a hydride and liquid hydrogen system were studied as possible means of storing hydrogen. The hydride system was shown to be unsuitable for use as the sole fuel system.

The liquid hydrogen supply system developed is shown in the drawing below. This system performs quite satisfactorily. Liquid hydrogen flows from the tank and is vaporized in heat exchange with the engine cooling water system. The heat exchanger is a simple shell and tube unit. The tube is bent so it makes five passes with the fluid in the shell.

The storage tank used was a 34 in outside diameter sphere with a capacity of 50 gallons. It can be filled in approximately 15 minutes if the tank is cold. The vehicle has been driven more than 300 miles over freeways and city streets, providing a smooth ride with more than adequate power for the 55 mph legal speed limit.

The modifications required to adapt this supply system to a conventional engine are also discussed. Gaseous hydrogen flows through pressure regulators and is combined with air in a mixing chamber. The fuel–air mixture is fed to the carburettor, converted to serve as a water-injection device. The combined hydrogen–air–water mixture then passes through a 100 mesh stainless steel screen to the intake manifold of the engine. (School of Engineering and Applied Science, University of California, Los Angeles, California, USA)



Plan of the LH_2 supply system for automobiles

Advances in metal properties at low temperatures

An area in which there seems to be an ever-increasing abundance of information is the study of cryogenic properties of materials, in particular metals.

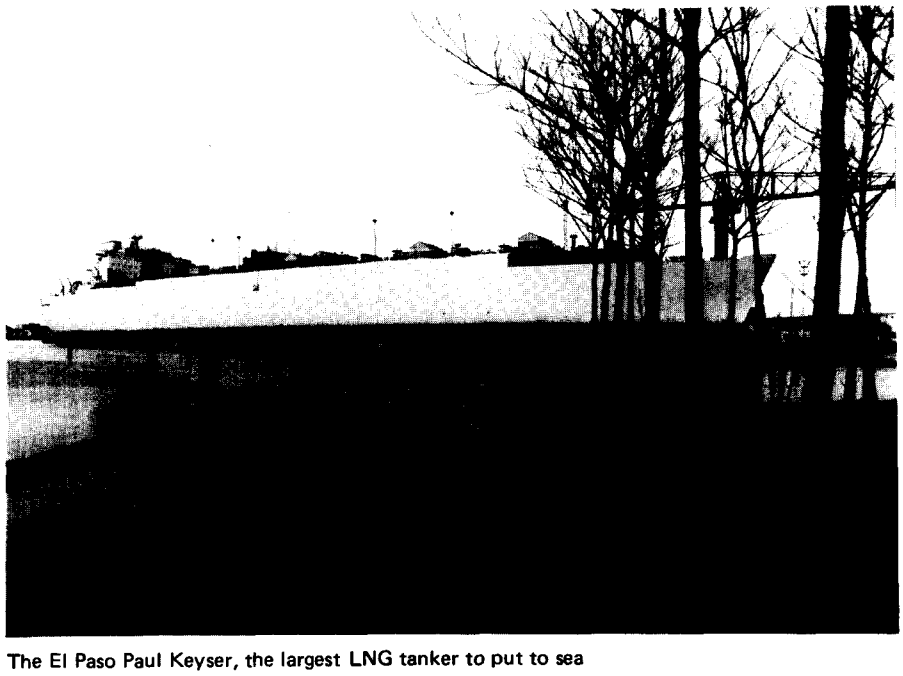
A recent issue of *Review of Metals Technology* contained an up-to-date report of significant developments throughout the world.

Topics covered included a brief review of the current ARPA/NBS materials research programme for superconducting machinery, Boeing's programme on space vehicle alloys, properties of Ti-5Al-2.5 Sn alloy — a joint research project at Carnegie-Mellon University and Lewis Research Center, the USSR study on nickel-based alloys and high nickel steels, fatigue crack propagation testing on specimens of high purity aluminium at Tohoku University in Japan, notched tension tests on aluminium alloy plate at Kobe Steel, and a study of stress–strain curves for nickel steel in Sweden.

The scope of each project is clearly listed in a series of tables and a reference list shows where additional information can be found. (*Review of Metals Technology* (30 May 1975) published by the Metal Properties Council, United Engineering Center, New York, NY 10017, USA)

Industrial news

France launches LNG giant



The El Paso Paul Keyser, the largest LNG tanker to put to sea

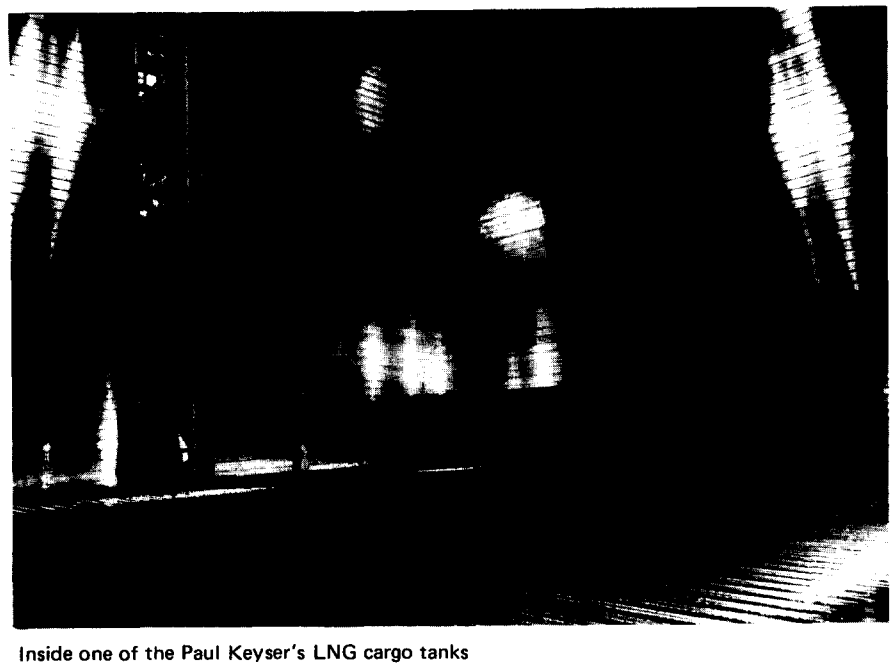
Increasing oil prices throughout the world have led to increased demands for natural gas supplies. New sources are being discovered fairly regularly but these tend to be remote from the centres of demand. Sea travel is the only feasible way of shifting large quantities of LNG and to cope with rapidly increasing demand, the shipbuilding industry are constructing progressively larger tankerships.

The latest, and biggest, supertanker to put to sea is the El Paso Paul Keyser, built by Chantiers de France-Dunkerque. Measuring 270 m (885 ft) in length and 42 m (136 ft) in breadth, the Paul Kayser has a total cargo capacity of 130 000 m^3 of LNG, equivalent to a weight of 63 700 tons. The cargo is divided between five tanks. These tanks consist of a double membrane within a double hull.

The insulation between the two membranes and between membrane and hull are plywood insulating boxes, strengthed by longitudinal and transverse stiffeners, and filled with silicone treated expanded perlite powder. Using this insulation the LNG boil-off is reduced to about 0.25% per day.

Each tank contains a submerged electropump. These together with other piping and pumping equipment enables the entire ship's cargo to be loaded or unloaded in twelve hours.

During recent sea trials the Paul Kayser reached a speed of 21.9 knots; maximum speed at full load should be around 21.6 knots. In addition the ship had very low vibration and sound levels, which ensured a comfortable voyage. (Chantiers de France-Dunkerque, Constructions Navales, BP 1503, 59381 Dunkerque, France)



Inside one of the Paul Keyser's LNG cargo tanks

CRYOGENIC news

Canadians try out niobium—tin magnet

The worth of multifilamentary Nb_3Sn will only be proved by the practical use of magnets wound from this material.

Oxford Instruments announced recently the successful construction and testing of a 10 T Nb_3Sn multifilamentary magnet. The magnet is now installed at the University of British Columbia, Canada where it will be used for nuclear orientation experiments.

The completed magnet has a 1 in bore diameter and measures 5 in in diameter by 8 in long. It was decided to use Nb_3Sn, rather than more conventional NbTi, as NbTi could not provide the very high field strength required over the magnet bore.

The material used to wind the magnet was IMI's Nb_3Sn superconductor. To overcome the great brittleness problem associated with Nb_3Sn, the magnet was wound from green wire, consisting of niobium filaments in a tin–bronze matrix. The entire magnet was then heat treated at 700°C to produce Nb_3Sn.

NMR field plots carried out on the final magnet showed a field homogenity of 1 part in 10^4 over a 1 cm diameter sphere. Other tests showed the magnet had negligible hysteresis and a residual field of less than 30 G.

Two similar magnets are being built for customers in France and Switzerland. (Oxford Instruments Ltd, Osney Mead, Oxon, UK)

Dilution refrigerator researches new He^3 phases

A 200 μW dilution refrigerator is being used at the School of Mathematical & Physical Sciences at the University of Sussex, UK to study new phases of He^3 existing below 3 mK.

The refrigerator, incorporates an 8.0 T superconducting magnet, plus a field cancellation coil to provide a large zero field region around the mixing chamber. The continuous base temperature measured externally to the mixing chamber by nuclear orientation thermometry, was 12 mK, with a cooling power of 3 μW at 25 mK.

This low base temperature, together with the 8 T magnetic field, can be used for direct adiabatic demagnetization of copper yielding temperatures below 1 mK.

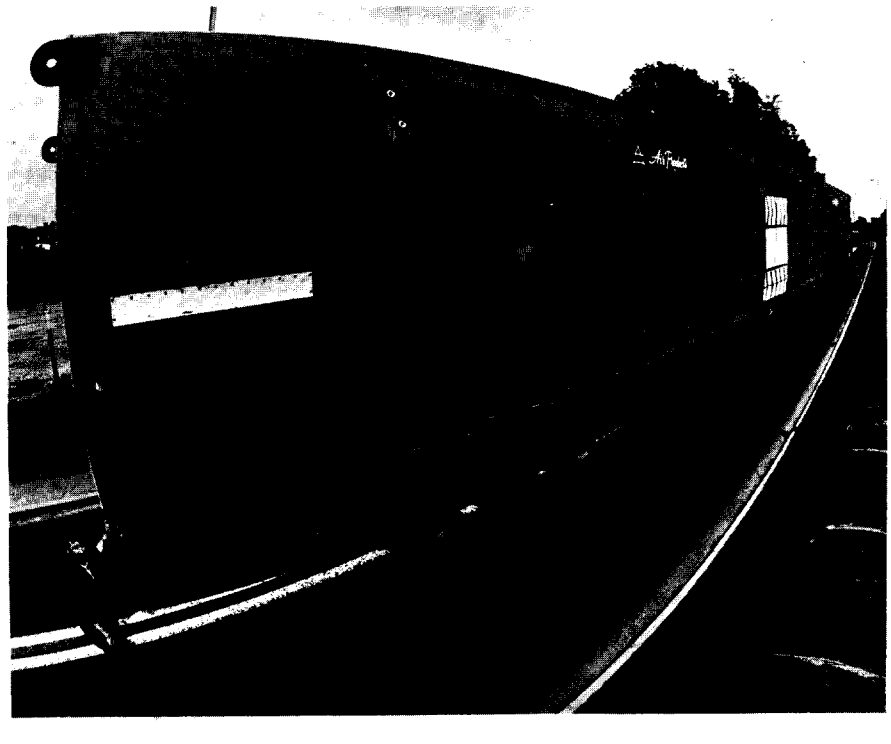
The new He^3 phases were first seen in a prototype dilution refrigerator used at the university for the past five years. (Oxford Instruments Ltd, Osney Mead, Oxford, UK)

Bound for Beavais

The traffic-stopping load, shown in the photograph opposite, is an Air Product's 'cold box' en route for Beavais in France. This 115 ft long and 67 ton unit will be the vital component in an air separation plant under construction for Prodair (Société des Produits de l'Air). Prodair, a subsidiary of Air Products and Chemicals Inc, is France's second largest industrial gas manufacturer.

The 'cold box' was built in the UK at Air Product's Ltd Acrefair factory in Wales. It was conveyed by road to Ellesmere Port and then via a specially chartered ship to Rouen. A 38 ton heat exchanger box, 22 liquefier box, and 4 ton expander box were shipped out together with the cold box.

Nearer home Air Products Ltd are hoping to complete an air separation plant near Glasgow by mid 1977 and are planning another large industrial gas facility at Bracknell, Berks. (Air Products Ltd, St George's Square, New Malden, Surrey, UK)



Air Product's 'cold box' on its way to Beavais, France