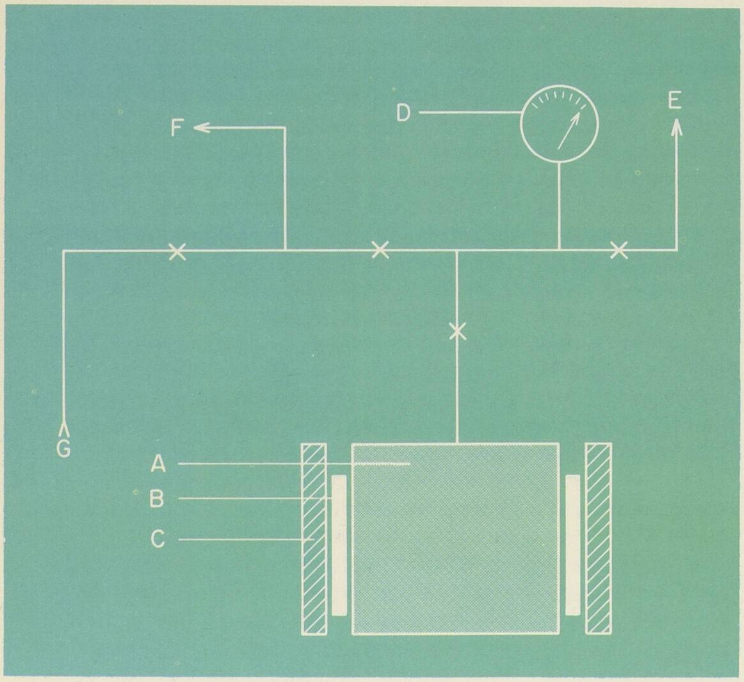

Diagram of model for hydrogen storage
Schéma du montage du réservoir

A – Metal Hydride	Hydrure métallique
B – Electrical Resistance Heater	Chauffage électrique
C – Insulation	Isolant
D – Pressure Gauge	Manomètre
E – To Application	Utilisation
F – To Vacuum Pump	Pompe à vide
G – Pressurized H_2 Supply	H_2 sous pression
X – Valves	Vannes

metal in the recharging process. If oxidation occurs, it creates a thin film on the metal, which acts as a barrier to absorption of hydrogen. Another area of concern over the future perfection of the hydride storage system involves the reduction of the metal to a powder during the actual hydriding process. To an extent, this is desirable because it produces a larger area of metal through which hydrogen can be absorbed and subsequently released. However, the final stable size distribution of these particles is not known and there exists a possibility that the metal particles would continue to be reduced in size until they would become too small to be held in the system.

While continuing to investigate these areas, Dr. Ledwell has discovered that a simple chemical process is responsible for the steady and predictable release of hydrogen from the metal as the heat is applied. The heat is transmitted through the container to the metal, but when the metal hydride starts to give off the gas, the heat is "blown" away by this action. The amount of heat reaching the metal hydride is reduced by this "blowing" process and the release of the gas is decreased allowing heat to again penetrate and activate the metal hydride. This continual process then forms a chemical control system for the release of hydrogen from metal hydride storage containers.

The development of full-scale containers would assist in clearing the way for widespread use of hydrogen. In fact, the basic technology for converting Canada to hydrogen as a source of energy is either available or close at hand.

While it has been demonstrated that internal combustion engines can easily be modified to operate on hydrogen as a fuel, the storage vessel weight can be prohibitive in certain applications despite the 75 per cent reduction gained through the metal hydride storage system. For instance, Dr. Ledwell doubts that hydrogen, in view of weight considerations, will ever become an economically justifiable alternative to gasoline for powering automobiles. One hundred (100) pounds of gasoline (about 12 gallons) provides the same energy as 40 pounds of hydrogen. But the container and the metal powder needed to store the 40 pounds of hydrogen would weigh about 2,000 pounds. Conventional bottling of that much hydrogen would result in a gross weight in excess of 8,000 pounds.

Instead, Dr. Ledwell is embarking upon another research mission which he feels better fits in with current technology governing hydrogen as a fuel in view of the storage problems. Since the automobile engine has become the subject of new restraints, including severe emission limitations and the shortage of gasoline, Dr. Ledwell proposes using a small amount of hydrogen in conjunction with gasoline to catalyze a lean gasoline-air mixture. Gasoline would therefore remain the principal source of energy for the car, but the addition of hydrogen would hopefully create high thermal efficiency, that is, more mileage per gallon of gasoline and virtually no emission problem.

However, the knowledge that moderate amounts of hydrogen can be obtained from various sources — waste hydrogen from plants producing materials by chemical processes and from coal by heating — Dr. Ledwell sees various practical uses for hydrogen as a fuel in the near future. The criterion is the weight associated with its storage. Thus, locomotives would be a suitable mode of transport to convert to hydrogen fuel. Weight does not have to be of great concern. Subways, submarines and the mining industry also could utilize it and benefit from its major advantage — the burning of hydrogen in underground locations presents no hazards from emissions. And again, weight is not an important consideration.

Insofar as home heating is concerned, Dr. Ledwell says a hydrogen-fuelled furnace would in effect require no stack pipe nor venting to the exterior of a dwelling. The flame is so clean-burning that venting is unnecessary. Presently, between 25 and 30 per cent of heat generated by oil- or gas-fired furnaces is exhausted up the chimney. In addition, the burning of hydrogen results in the generation of water vapor.

"We're not sure whether the humidity level generated by an open hydrogen flame would be suitable or excessive for a Canadian home," he says.

Storage of hydrogen by homeowners need not be a problem. Hydrogen generated at a nuclear power station, for instance, would simply be piped into urban areas. The distance covered by the pipelines would be considerable because of the traditional remote location of nuclear power facilities. The metal hydride system would be utilized for storing excess hydrogen which could then be used during peak demand periods, and the hydrogen would be introduced into the pipeline network under pressure. The pipes themselves would act as pressure containers. The consumer would receive hydrogen in the same manner in which hundreds of thousands of homes now receive natural gas. □

David Smithers