

## FUEL CELLS

### Ammonia - Oxygen Fuel Cell

E. J. CAIRNS, E. L. SIMONS and A. D. TEVEBAUGH, *Nature*, 1968, 217, (5130, Feb. 24), 780-781

An  $\text{NH}_3\text{-O}_2$  fuel cell uses 54 wt. % aqueous KOH electrolyte and Teflon-bonded Pt black electrodes with 51 mg Pt/cm<sup>2</sup>. Total cell resistance was 0.03 ohm, the cathode curve showed no limiting current density up to at least 1000 mA/cm<sup>2</sup> at 140°C and the anode voltage rose sharply at current density >700 mA/cm<sup>2</sup>. For current densities between 20 and 200 mA/cm<sup>2</sup> the anode performance improved by almost 75 mV between 109 and 191°C. Performance level of these cells exceeds those of all fuels other than H<sub>2</sub> or N<sub>2</sub>H<sub>4</sub>.

## TEMPERATURE MEASUREMENT

### Practical Temperature Scales between 11K and 273K

H. PRESTON-THOMAS and R. E. BEDFORD, *Metrologia*, 1968, 4, (1), 14-30.

The reproducibility of proposed scales, which might replace four national scales below 90.18°K, is analysed and the scales are related to best estimates of the thermodynamic scale. Lack of reproducibility below 50°K may be tolerated or the thermometer characteristics must be restricted. The proposed scales have systematic variation in degree size with temperature. All this work is based on the Pt resistance thermometer.

## NEW PATENTS

### METALS AND ALLOYS

#### Manufacture of Precious Metal Spheres and Spheroids

INTERNATIONAL NICKEL LTD.  
*British Patent* 1,103,396

Small spheres or spheroids of alloys of Ru, Rh, Os and Ir are used for points of moving elements, e.g. in compasses, and fountain pen nibs. They are produced by heating a powder of one of these four metals with a matrix mixture of Pd or Pt with Au or Ag above the melting point of the matrix but below that of the four metals, forming the product into spheres, cooling and leaching out the matrix.

#### Niobium Alloys

BIRMINGHAM SMALL ARMS CO. LTD.  
*British Patent* 1,103,724

The strength of Nb-W alloys, with or without Ta, is improved by the addition of one or more of Ru, Os and Ir. The range claimed is at least 30% Nb, 10-25% W, 0-40% Ta and 0.1-10% Pt metal. Small amounts of Hf and Zr may also be present.

#### Preparation of Finely Divided Metals

INTERNATIONAL NICKEL LTD.  
*British Patent* 1,109,890

Finely divided Ir or Ru is produced by thermally decomposing a halogen-free Ir or Ru compound at up to 400°C in non-oxidising conditions, the Ir or Ru atom being in a complex with NH<sub>3</sub> and/or oxalate groups, the other groups in the compound leaving no residue on decomposition. A typical compound is  $(\text{NH}_4)_3[\text{Ru}(\text{CO})_3(\text{C}_2\text{O}_4)]$ .

#### Manufacturing Non-Magnetic, Elastic Metallic Materials

ZAIDAN HOJIN DENKI JIKI ZAIRYO KENKYUSHO  
*British Patent* 1,110,045

These materials are produced from metallic Pd or an alloy of 30-100 wt% Pd and 70-0 wt% Au by heating the metal or alloy at above 600°C but below its melting point for more than one minute and then slowly cooling it to achieve annealing. It is permissible for 0-5% of a variety of other alloying elements to be present.

#### Reorientation of Stabilised Platinum

JOHNSON, MATTHEY & CO. LTD.  
*Italian Patent* 787,630  
*French Patent* 1,504,716

Mechanical properties of a strengthened metal or alloy are improved by cold-working and annealing. The cold-working causes recrystallisation during annealing with a grain structure elongated in the direction of working. Pt and Rh-Pt are strengthened prior to treatment by the inclusion of a dispersed carbide.

#### Platinum Claddings for Refractory Metals

JOHNSON, MATTHEY & CO. LTD.  
*Italian Patent* 794,340

Articles comprise refractory metal cores, such as Nb, Ta, Cr, or an alloy thereof, or Mo, which do not form volatile oxides at the operating temperature nor form alloys with the Pt or Pt alloy cladding at melting points below this temperature. A barrier layer between core and cladding consists of a compatible refractory carbide, silicide, boride, sulphide, nitride, or oxide, e.g. a rare

earth metal oxide, carbide or nitride. This corresponds to *Belgian Patent* 697,292.

## CHEMICAL COMPOUNDS

### Production of Platinum and Palladium Oxides

MATTHEY BISHOP INC.

*U.S. Patent* 3,357,904

These oxides are made by electrolysis using an electrode comprising or containing Pt and/or Pd in a bath of molten alkali metal hydroxide.

## ELECTROCHEMISTRY

### Electrodes for Cells

CENTRAL ELECTRICITY GENERATING BOARD

*British Patent* 1,104,374

Electrodes for electrolytic cells particularly for the direct electrolysis of sea water to produce hypochlorite is based on a cheaper anode material which is covered with a Pt-Ni alloy containing not less than 30% Pt covered with a pure Pt film.

## ELECTRODEPOSITION AND SURFACE COATINGS

### Surface Treatment of Titanium

IMPERIAL METAL INDUSTRIES (KYNOCHE) LTD.

*British Patent* 1,105,388

Before plating Pt on to Ti surfaces, they are pretreated with an oxalic acid solution at elevated temperature. The adherence of the Pt electrodeposit is improved.

### Platinum Plating of Titanium

STE UGINE

*U.S. Patent* 3,357,858

A Pt group metal plated deposit adheres well to articles with a Ti or Ti alloy surface when the surface is pretreated with a mixture of HCl and HNO<sub>3</sub> and the deposit is heated at 300°C.

### Activation of Glass before Chemical Plating

INTERNATIONAL BUSINESS MACHINES CORP.

*U.S. Patent* 3,370,973

Glass is coated with an organic solution of nickel chloropalladate and then heated at elevated temperature to convert the coating to a Ni-Pd film. This film catalysed subsequent chemical (electroless) plating baths.

### Coatings on Easily Oxidised Metals

INTERNATIONAL NICKEL LTD.

*French Patent* 1,500,545

Bodies formed of Ir, Ru, Mo, W or their alloys with noble metals are protected against oxidation at high temperatures by coating with a ternary alloy containing Au and Pt or Pd.

## Platinum Metal Plating

DEUTSCHE GOLD- & SILBER-SCHNEIDANSTALT

*German Patent* 1,261,367

Refractory metals are coated by applying a sulphur-free chelate of a Pt metal dissolved in an organic solvent, allowing the solvent to evaporate and then decomposing the metal chelate at a temperature up to 400°C. Aliphatic dinitriles and decarboxylic acids are suitable chelating agents.

## JOINING

### Brazing Methods for Porous Refractory Metals

T.R.W. INC.

*U.S. Patent* 3,363,306

Porous W is bonded to other refractory metals, such as Mo or massive W, using a thin layer of Rh which wets the metal surfaces and forms an alloy on heating.

### Refractory Ceramic to Metal Seal

NORTH AMERICAN PHILIPS CO.

*U.S. Patent* 3,366,466

Ceramics are metallised with a spongy layer of Mo and/or W, the pores of the spongy layer are filled with a Ta-Rh, Rh-Mo or Mo-Ru alloy which also covers the surface and then a braze containing a Ta or Nb alloy is applied. See also *British Patent* 1,108,764.

## HETEROGENEOUS CATALYSIS

### Production of Unsaturated Mononitriles

FARBWERKE HOECHST A.G.

*British Patent* 1,103,046

Acrylonitrile and related compounds are produced by reacting an olefin with HCN and O<sub>2</sub> at an elevated temperature in the presence of a Pt metal catalyst, especially a supported Pd catalyst.

### Production of Vinyl Acetate

KNAPSACK A.G.

*British Patent* 1,103,125

Vinyl acetate is produced from C<sub>2</sub>H<sub>4</sub>, CH<sub>3</sub>COOH and O<sub>2</sub> in the gas phase using a carrier catalyst containing 0.1–6 wt% (preferably 0.5–2%) metallic Pd, 0.01–10 wt% (preferably 0.03–1%) metallic Au and 1–20 wt% (preferably up to 5 wt%) alkali metal formate or acetate. See also *British Patent* 1,107,495.

### Hydrocracking Process

ESSO RESEARCH & ENGINEERING CO.

*British Patent* 1,103,393

The activity of catalysts made by depositing a Pt metal on a base-exchanged zeolite with 6–15Å pore openings is maintained and increased by adding halogens or a halogen source to the hydrocarbon feed for hydrocracking. See also *British Patent* 1,106,338.

### Preparing Cyclohexane

STAMICARBON N.V.

*British Patent 1,104,275*

$C_6H_6$  containing more than 0.5 mg/l of S may be successfully hydrogenated in two stages using Pt metal catalysts: in the first stage all S compounds are converted to  $H_2S$  but only some  $C_6H_6$  is converted while in the second stage the remaining  $C_6H_6$  is hydrogenated. Pt/ $Al_2O_3$  is a suitable catalyst.

### Production of Allyl Chloride

FARBWERKE HOECHST A.G.

*British Patent 1,104,361*

Allyl chloride or methallyl chloride is produced by contacting  $O_2$  and a mixture of a 3-4C olefin and HCl and/or a 3-4C monochloroparaffin with Ru, Pd, Ir, Pt, or PtO as catalyst.

### Preparation of Piperidine

RHONE-POULENC S.A.

*British Patent 1,106,168*

Piperidine is produced by reacting glutaric acid or its anhydride with  $NH_3$  and  $H_2$  at elevated temperature and pressure in the presence of a hydrogenation catalyst. The preferred catalyst is based on Ru, e.g. Ru/C.

### Production of Vinyl Acetate

FARBWERKE HOECHST A.G.

*British Patent 1,106,236*

$CH_3COOH$  is reacted with  $C_2H_4$  and  $O_2$  in the gaseous phase in the presence of a solid catalyst containing Pd, Pt, Ru, Rh or Ir in elementary form together with a Mn compound on a support.

### Production of Metallic Oxide Catalysts

JOHNSON, MATTHEY & CO. LTD.

*British Patent 1,106,814*

Electrolytic production of oxides of Pt and/or Pd or oxides of Pt and/or Pd mixed with oxides of other metals not harmful to the catalytic properties of the Pt and/or Pd oxides by electrolysis of the appropriate Pt, Pd, Pt alloy or Pd alloy anode in a molten bath of alkali metal halide and nitrate.

### Catalyst

STE FRANCAISE DES PRODUITS POUR CATALYSE

*British Patent 1,107,276*

$Al_2O_3$  is treated with aqueous solutions of fluoboric and  $H_2PtCl_6$  in molar proportions of 3.5-4.5 mols fluoboric acid per mol  $H_2PtCl_6$ . The catalyst is especially for catalytic reforming.

### Production of Phenols

IMPERIAL CHEMICAL INDUSTRIES LTD.

*British Patent 1,108,256*

An aromatic compound is oxidised to a phenol using an  $O_2$ -containing gas in a liquid phase containing  $HCOOH$  and a transition metal catalyst, especially Pd, Rh, Ir or other noble metal.

### Catalytic Oxidation of Alcohols

IMPERIAL CHEMICAL INDUSTRIES LTD.

*British Patent 1,109,228*

Primary and secondary aliphatic alcohols are oxidised to aldehydes, ketones and/or acids by contact with  $O_2$  in the presence of Ir. The Ir is preferably unsupported and is best precipitated from an iridate or iridite.

### Isomerisation of a Hydrocarbon Fraction

SHELL INTERNATIONALE RESEARCH MIJ. N.V.

*British Patent 1,110,170*

Normal paraffins and naphthenes in a 5-7 C hydrocarbon fraction are hydrogenated in the presence of 100-5000 ppm S and a noble metal catalyst composed with a halogenated  $SiO_2$  cracking component to bring about isomerisation. The catalyst is preferably Pd or Pt on  $SiO_2$  containing F.

### Production of Hydrogen Cyanide

E.I. DU PONT DE NEMOURS & CO.

*U.S. Patent 3,360,335*

Pt and Pt-Rh gauze catalysts, used in the oxidation of an  $NH_3$ /hydrocarbon mixture, are treated with aqua regia to activate or reactivate the catalyst.

### Hydrocracking Process

UNION OIL CO. OF CALIFORNIA

*U.S. Patent 3,360,458*

Feedstocks containing both polycyclic and non-polycyclic hydrocarbons are cracked using a mixture of crystalline zeolite catalyst and an amorphous cogel catalyst, the zeolite containing a higher proportion of Group VIII noble metal catalyst metal. Pt, Pd, Rh and Ir are the preferred metals.

### Platinum Metal Catalyst Activation

ESSO RESEARCH & ENGINEERING CO.

*U.S. Patent 3,360,481*

A catalyst consisting of a Pt metal, especially Pd, on a zeolite support is activated using dry  $H_2$  at up to 300°F until activation is partly complete and then with wet  $H_2$  at a temperature above 300°F.

### Cyclohexylamine Production

ABBOTT LABORATORIES

*U.S. Patent 3,364,261*

The reaction of  $C_6H_5OH$ ,  $NH_3$  and  $H_2$  at low pressure is catalysed by Rh metal.

### Catalytic Gasoline Reforming

UNIVERSAL OIL PRODUCTS CO.

*U.S. Patent 3,365,392*

A gasoline is reformed to high octane fuel and LPG by mixing it with  $H_2$  and S and passing it at 800-1100°F over a platinised or palladised zeolite.

### Hydrogenation of Benzylic Compounds

CONTINENTAL OIL CO.

*U.S. Patent* 3,366,695

Phenyl carbinol, phenyl alkyl carbinol, phenyl alkyl ketone, benzyl alkyl ethers and benzyl alkanates are reduced to the corresponding cyclohexyl compounds using a catalyst consisting of a porous support carrying Rh or Ru and promoted with an alkali metal base.

### Exhaust Gas Combustion Catalyst

UNIVERSAL OIL PRODUCTS CO.

*U.S. Patent* 3,367,888

The catalytic activity of noble metal catalysts, e.g. Pt/Al<sub>2</sub>O<sub>3</sub>, in burning exhaust gases is promoted by incorporating 0.1–1.5 wt% of thiomalic, thioglycolic or mercaptopropionic acid.

### Acyclic Olefin Isomerisation

ETHYL CORP.

*U.S. Patent* 3,367,988

$\alpha$ -Olefins are isomerised to internal olefins using a Pt metal on an inert support and an alcohol as promoter, e.g. Pd/C and n-octanol.

### Cyclododecene Production

GEIGY CHEMICAL CORP.

*U.S. Patent* 3,369,052

Cyclododecatriene is selectively reduced to cyclododecene in good yield in the absence of solvent, using H<sub>2</sub> and Pd catalyst, e.g. Pd black or PdO.

### Packaging System

AIR PRODUCTS & CHEMICALS INC.

*U.S. Patent* 3,369,859

Traces of O<sub>2</sub> in a package filled with inert gas containing H<sub>2</sub> are eliminated by catalytic combination on a cylindrical pellet of refractory oxide carrying 0.1–1% Pd or Pt.

### Finely Divided Metals

ESSO RESEARCH & ENGINEERING CO.

*U.S. Patent* 3,369,886

Finely divided metals, especially Pt, are obtained by precipitating the metal from its salts while simultaneously precipitating Al(OH)<sub>3</sub>. The Pt is then freed from Al<sub>2</sub>O<sub>3</sub> with KOH to give a catalyst of high surface area.

### Halogen Exchange Process

UNIVERSAL OIL PRODUCTS CO.

*U.S. Patent* 3,370,096

The exchange of halogen in a hydrocarbon with the halogen of a Friedel-Crafts metal halide in the presence of H<sub>2</sub> is catalysed by a Group VIII metal, preferably Pt/Al<sub>2</sub>O<sub>3</sub>.

### Hydrocarbon Conversion Process

UNIVERSAL OIL PRODUCTS CO.

*U.S. Patent* 3,371,126

Catalytic reforming with a Pt catalyst, and hydro-

dealkylation are used to produce aromatic hydrocarbons and town gas.

### Platinum Coating and Impregnating Method

JOHNSON, MATTHEY & CO. LTD.

*Dutch Appln.* 67.02,039

A PtO<sub>2</sub> or a mixture of such an oxide with up to 50% of oxides of Rh, Ru, Ir and/or Pd is reacted with a dispersing medium containing a 2–5 C aliphatic alcohol to form a Pt dispersion. This dispersion is applied to a support and the Pt salted out on to the support. The organic material present is then oxidised and the water expelled.

### Selective Catalytic Reduction

JOHNSON, MATTHEY & CO. LTD.

*Italian Patent* 787,791

Reduction of a ketone or of an aromatic aldehyde to the corresponding alcohol uses H<sub>2</sub> and Pd/charcoal catalyst in the presence of a primary aromatic amine, e.g. C<sub>6</sub>H<sub>5</sub>NH<sub>2</sub>, *p*-toluidine or benzylamine, or of a heterocyclic tertiary amine, e.g. C<sub>5</sub>H<sub>5</sub>N or quinoline.

### Mixed Noble/Base Metal Oxide Catalyst

JOHNSON, MATTHEY & CO. LTD.

*Italian Patent* 787,819

The catalyst consists of a 3:1 intimate homogeneous mixture of a Pt metal oxide, e.g. oxides of Pt or Pd, with a base metal oxide, e.g. at least one of Fe, Co, Ni, and Cu. The catalyst mixture is prepared by mixing Pt metal and base metal salts and heating or treating them in the presence of a reactant such as NaNO<sub>2</sub>.

## HOMOGENEOUS CATALYSIS

### Organosilicon Compositions

DOW CORNING CORP.

*British Patent* 1,104,117

A liquid curable system consists of a siloxane, a liquid terminal diene and a catalytic amount of Pt, especially H<sub>2</sub>PtCl<sub>6</sub>.

### Production of Alkyl Vinyl Ethers

IMPERIAL CHEMICAL INDUSTRIES LTD.

*British Patent* 1,105,293

In this multistage process, the first stage consists of reacting C<sub>2</sub>H<sub>4</sub> with H<sub>2</sub>O in the presence of a Pd salt or coordination compound and the usual acetate ions, O<sub>2</sub>, Cu salt, etc., to give vinyl acetate. In the second stage an identical or similar catalyst (e.g. PdCl<sub>2</sub>) is used to give the alkyl vinyl ether from the vinyl acetate.

### Production of Acetaldehyde

EASTMAN KODAK CO.

*British Patent* 1,109,483

C<sub>2</sub>H<sub>4</sub> is contacted with an aqueous oxidising composition, at pH 0.5–3.5, containing CuCl<sub>2</sub> and a catalytically active Pd compound such as PdCl<sub>2</sub> to form a complex which is then hydrolysed.

### Producing Vinyl Acetate

ASAHI KASEI K.K.K.

*British Patent 1,110,663*

$C_2H_4$ ,  $CH_3COOH$ ,  $O_2$  and a small amount of  $HCl$  are reacted in the presence of a catalyst consisting of (a) Pt, Pd, Rh, Ru, Ir or their chlorides or oxides, hydroxides and salts which readily provide the chlorides of these metals and (b) Cu, Ag, Zn, Cd, Sn, Pb, Cr, Mo, W, Fe, Ni or their chlorides or oxides, hydroxides and salts which readily provide these metal chlorides.

### Lower Saturated Aliphatic Nitriles

ASAHI KASEI K.K.K.

*British Patent 1,110,687*

Lower saturated aliphatic nitriles (especially propionitrile and normal and iso-butyronitrile) are produced by the reaction of  $C_2H_4$  and/or  $C_3H_6$  and  $HCN$  in catalytic addition at  $200-450^\circ$  in the presence of Pd and/or Rh and/or one of their compounds. See *British Patent 1,110,682*.

### Preparation of Alkenyl Esters

SHELL OIL CO.

*U.S. Patent 3,358,016*

Vinyl esters are produced from a 2-4C unsaturated vinylic halide and a Na, Cu or Fe 2-18C monocarboxylate in the presence of DMF, dimethoxyethane and  $PdCl_2$  but in the absence of free carboxylic acid.

### Redox Catalytic Oxidation of Olefins to Aldehydes and Ketones

UNION CARBIDE CORP.

*U.S. Patent 3,365,498*

The catalyst consists of a Pd, Pt, Ir, Rh, Ru or Au inorganic or organic salt or a diketo complex and a similar compound of a transition metal.

### Oxidation of Olefins to Ketones

GULF RESEARCH & DEVELOPMENT CO.

*U.S. Patent 3,365,499*

A 6-40 C olefin is oxidised by a mixture of a quinone or other oxidising agent and an aprotic solvent with a Pt metal catalyst, e.g.  $PdCl_2$ .

### Hydrogenation of Unsaturated Compounds

SHELL OIL CO.

*U.S. Patent 3,366,646*

Non-aromatic C-C unsaturation is hydrogenated over a tris(tertiary phosphine or arsine)rhodium nitrosyl.

### Polymerisation of Bicycloheptene Compounds

UNIROYAL INC.

*U.S. Patent 3,367,924*

Olefins containing a bicyclo (2,2,1)-hept-2-ene ring system are polymerised in aqueous emulsion using a catalyst based on an Ir or Ru compound (e.g.  $IrCl_3$ ) and a reducing agent.

### Peroxide-bleaching of Wood Veneers

DR. KURT HERBERTS & CO.

*German Patent 1,259,088*

The  $H_2O_2$  bleaching of wood veneers can be activated by a metal colloid sol, e.g. an ammoniacal Pt sol containing 2.2% Pt. The bleached wood is free from traces of peroxide.

### Carbonylation of Olefins and Acetylenes

BADISCHE ANILIN- & SODA -FABRIK A.G.

*German Patent 1,261,509*

Carbonylation is catalysed by a deacidified solution containing Pd salt complexed with organic phosphine, e.g. bis(tritylphosphine) $PdCl_2$ .

### Hydrogenation of Water-Soluble Compounds

JOHNSON, MATTHEY & CO. LTD.

*Belgian Patent 701,238*

*Dutch Appln. 67,09,685*

Certain new hydridopentaminorhodium compounds of formula  $(HRhX_6)^{+r}$ , where X is 5 mols of  $NH_3$  or 4 mols of  $NH_3$  and 1 mol  $H_2O$ , are very suitable hydrogenation catalysts, especially for carboxylic acids and other compounds dissolved in  $H_2O$ .

## FUEL CELLS

### Catalyst Composition

ESSO RESEARCH & ENGINEERING CO.

*British Patent 1,108,317*

A catalyst for use in electrochemical reaction is made from a mixture of Pt, Re and Ru, each metal being relatively inactive when used alone. The proportions claimed are 40-70% Pt, 1-40% Re and 1-40% Ru, by weight and especially active catalysts are obtained with an atomic ratio of 68.5:15:16.5 (Pt:Re:Ru) where  $CH_3OH$  is fuel.

### Fuel Cells

ESSO RESEARCH AND ENGINEERING CO.

*British Patent 1,108,776*

A fuel cell producing current from fuel anodic oxidation, having hydrophobic portions, e.g. Pt black on pte, is operated with a fluorocarbon sulphonic or carboxylic acid electrolyte.

### Rhodium Catalyst for Fuel Cells

AMERICAN CYANAMID CO.

*U.S. Patent 3,357,863*

An inexpensive multimetal  $H_2$  fuel cell electrode consists of a mixture of 0-47.5% Pt, 40-95% Rh and 5-20% W oxide, where the amount of Pt is not more than 50% the amount of Rh.

### Platinum-Rhodium Fuel Cell Catalyst

AMERICAN CYANAMID CO.

*U.S. Patent 3,357,863*

A  $H_2$  fuel cell used a four-component catalyst mixture of (a) 15-35% Pt, (b) 15-35% Rh, (c) 5-35% W oxide and (d) 5-35% Mo oxide.

## Platinum Metals in Fuel Cell Electrodes

UNION CARBIDE CORP.

*U.S. Patent* 3,364,074

C-containing electrodes for fuel cells are impregnated with Pt, Pd, Rh or Ir and simultaneously waterproofed by the application of a complex of one of these metals and a suitable diketone, e.g. Pd or Pt acetylacetonate.

## CHEMICAL TECHNOLOGY

### Mounting of Foils Permeable Only to a Specific Gas

PROTECH CO.

*British Patent* 1,106,876

In order to be able to use thinner, cheaper foils (especially Pd alloy foils permeable to  $H_2$ ), the foil is sinter-bonded to a support of sufficient rigidity which is made of metal at least on the side facing the foil.

### Structures Incorporating Thin Metal Membranes

ENERGY CONVERSION LTD.

*British Patent* 1,107,811

$H_2$  permeable membranes, for example, are produced from a perforated support which is bonded to a gas permeable metal or alloy which seals off the holes in the support. Thus in an example a Ni disc is indented on one side, plated on this side with Pd and then Ag and finally abrasive used to remove the projecting material from the reverse side. This leaves holes covered with a Pd-Ag membrane.

### Hydrogen Purification Apparatus

T. EGUCHI et al.

*U.S. Patent* 3,368,329

$H_2$  is purified by diffusion through a bundle of Pd or Pd alloy tubes in a diffusion chamber.

### Hydrogen Diffusion Tubes

JOHNSON, MATTHEY & CO. LTD.

*German Patent* 1,245,921

A closing plug for sealing the open end of Pd or Pd-Ag alloy  $H_2$  diffusion tubes consists of material with approximately the same coefficient of thermal expansion and dimensioned to fit tightly with a projecting, threaded spigot of smaller diameter than the tube and used to form a means for attachment of or for stabilising an internal support for the tube. This corresponds to *British Patent* 1,009,326.

### Hydrogen Diffusion Tubes

JOHNSON, MATTHEY & CO. LTD.

*Dutch Patent* 123,628

A diffusion tube used for separation of  $H_2$  from gaseous mixtures, made of Pd or of 25 wt.% Ag-Pd, is made more robust and its life is prolonged by incorporating stainless steel or Ni coil

springs or metal or ceramic rods as stiffening members to prevent flattening of the tube walls yet permit free passage of gas. This corresponds to *British Patent* 966,122.

## ELECTRICAL AND ELECTRONIC ENGINEERING

### Platinum-Platinum Oxide Electrodes

CONTINENTAL OIL CO.

*British Patent* 1,103,413

Oxide electrodes for detecting corrosive attack are produced by immersing a rod of Pt metal in fused alkali metal nitrate at a temperature of about 400°C and for a period of at least one hour. The oxide layer obtained consists essentially of 3-7 parts monoxide and 1 part dioxide by weight. See also 1,103,414.

### Tailoring of Resistors

INTERNATIONAL BUSINESS MACHINES CORP.

*British Patent* 1,107,788

A film resistor consisting of an oxide semiconductor material with a noble metal additive (e.g. PdO with Au or Ag) is tailored by subjecting a portion of the resistor to electromagnetic radiation to reduce its resistance.

### Spark Plugs

ROBERT BOSCH G.M.B.H.

*British Patent* 1,110,255

A spark plug using less Pt in its construction has a Pt head formed as a plate or disc-like flange which is pressed into the insulator bore so that it deforms and seals the opening of the bore. The opening and the bore portion then form a casting chamber for the remainder of the electrode.

### Iridium and Rhodium Semiconductors

AMERICAN CYANAMID CO.

*U.S. Patent* 3,356,464

New semiconductors claimed are IrAsSb, IrPAs, RhAsSb and RhPAs, although the text covers a slightly larger range of compounds such as RhSb<sub>2</sub> and IrP. The semiconductors can be used in thermoelectric devices.

### Ductile Ruthenium Alloy

INTERNATIONAL NICKEL CO. LTD.

*U.S. Patent* 3,362,799

Ru powder is mixed with 0.1-25 wt% Re powder and processed in the usual way to give a ductile alloy, e.g. for sparking plugs.

### Gold-Palladium Alloy with High Specific Resistance

DEUTSCHE GOLD- & SILBER-SCHNEIDANSTALT

*German Patent* 1,262,021

The alloys of *German Patent* 1,236,207 consisting of 18-75% Au, 75-20% Pd, 2-15% Fe and 0.4-1.2% Al are modified by replacing some or all of the Al by B, Ga and/or In.