71 Nuclear structure theory—

J. M. Irvine (Physics Bulletin, **21**, 149, 1970). Introduction, shell model basis, nuclear matter, finite nuclei, deformed nuclei; 4 figures and bibliography.

72 Waste control – a must for cost reduction—

G. M. Bhattacharya (Science and Engineering, **23**, 85, 1970). Material, labour, overhead expense and miscellaneous wastages.

73 Preventive maintenance in chemical industries in India—

S. Visweswaran (Indian Chem. Engineer, **12**, No. 1, 12, 1970). Introduction, preventive maintenance practices, costs, personnel; 2 figures and 13 references.

74 Lasers cut machining costs—

(Tooling, **24**, No. 7, 11, 1970). Introduction, thin film machining, automatic dynamic balancing, application of gas laser, gas jet laser cutting; 6 figures.

75 Universities and the community—

M. R. Gavin (Physics Bulletin, **21**, 292, 1970). Introduction, science in the universities and in industry, physics and the community, university autonomy, committees and councils, miscellaneous; 2 tables and bibliography.

76 Review of digital storage technology—

W. Renwick (Physics Bulletin, **21**, 306, 1970). Introduction, magnetic high – speed random–access stores, ferrite cores, flat magnetic films, plated wire, semiconductor arrays, superconducting storage, magnetic surface recording, optical storage techniques; 11 figures and bibliography.

77 A new look at natural rubber—

P. W. Allen, D. Barnard and B. Saville (Chemistry in Britain, **6**, 382, 1970). Introduction, production/consumption R and D, vulcanization chemistry, oxidative degradation of NR, protection against oxidation; two tables on production statistics, 6 illustrations and 13 references.

78 New developments in filtration—

P. H. Schwabe (Chemistry in Britain, **6**, 388, 1970). An approach to respiratory protection, particulate/vapour filtration respirators, large filters. Four tables, 8 figures and 14 references.

—T. L. R.

(B) BATTERIES AND FUEL CELLS

1 A Study of Carbon – tungsten composite electrodes as cathode materials for molten salt batteries—

W. K. Behl, D. D. Beals and G. R. Frysinger (J. Electrochem. Soc. Japan, **37**, 215, 1969). The cathode capacities of the electrodes were determined from a study of the charge and discharge curves of the cells: Li-Al/LiCl-KCl/C and Li-Al/LiCl-KCl/C-W. The electrodes were found suitable; 2 tables, 7 figures and 20 references.

2 Batteries, secondary. Portable lead–acid type—

(Defence Standard, U.K., DEF 61–9: Part 1, November 5, 1969); Lead Abs., **10**, 33, 1970. Requirements are specified for the general design, manufacture, qualification approval, testing and inspection of portable lead–acid batteries other than commercial types, providing electrical power for communication equipment, aircraft servicing, fighting vehicles, mechanical transport, and for miscellaneous services in ships. Related specifications are listed, and particular requirements for each battery are presented in 6 supplements.

3 Opportunity for lead – acid battery manufacture in Missouri—

J. L. Stark (Univ. Missouri Booklet, 1969, 33 pages): Lead Abs., **10**, 51, 1970. The feasibility is examined of additional manufacturing facilities in Missouri for the production of lead – acid batteries – starting, lighting and ignition: market potential, costs, plant layout and newly developed polypropylene containers. Sixteen tables and 7 figures.

4 First commercial electric car—

(Elec. Rev., **185**, 640, 1969): Lead Abs., **10**, 51, 1970. The first electric city car to be designed for quantity production is described. The lead – acid batteries, developed by Oldham International for the Enfield Automotive car, have thin plates which are reinforced to prevent buckling. It is possible to charge the battery at high rate, giving an

80 per cent charge in one hour. The car has 4 batteries weighing 110 lbs, rated at 12V, 11 Wh/lb and the volume of the electrolyte is larger than normal to accommodate the high charge and discharge rates. One table, 2 figures and illustration.

5 Multi-cell storage battery—

(U. S. Patent 3,484,299, 1967); Lead Abs,, **10**, 52, 1970. Description of a multi-cell lead-acid storage battery, suitable for starting international combustion engines, with the electrical connections between adjacent cells located inside the battery and above the liquid electrolyte.

6 Development of Zinc – Air 24 volt, 20 ampere-hour standard line battery system—

P. Noorily (U. S. Govt. Res. Develop. Rept. AD 690 856, 1969, 49 pages); Zinc Abs., **28**, 133, 1970. The design, characteristics and operation of a battery weighing 84 lbs and having a maximum current capability of 4.3 ampere. Water addition required at times in previous projects is unnecessary with this battery. Four tables, 14 figures and 11 illustrations.

7 New fast charging power source—

P. Bro and N. Marincic (J. Electrochem. Soc., **117**, 131, 1970). A new type of rechargeable cell is described, comprising the system cadmium/zinc chloride, cadmium chloride, sodium perchlorate/silver chloride/silver. Cells can be charged between 30 and 90°C by a dual charging process involving the primary deposition of zinc and its subsequent replacement by cadmium from solution. The open circuit voltage of the cells amounts to 0.75 V and they can be discharged at high or low rates with low overvoltages Gas evolution does not take place at the high rates of charge, and sealed cells have been operated through 10 cycles with discharge efficiencies higher than 95 per cent. The high rate capability is associated with a low specific capacity and low energy density. One table, 4 figures and 1 illustration.

8 Wide temperature range charging system controlled by battery acceptance—

J. A. Mas (S. A. E. Rept. No. 680393, 1969); Zinc Abs. **28**, 134, 1970. The concept of charge acceptance is discussed for batteries such as the lead-acid and nickel/cadmium. A pressure control charging system is described together with its performance characteristics over a wide temperature range. The system completely prevents overcharging at high temperatures and ensures full battery capacity even at very low temperatures. One table, 11 figures and 2 illustrations.

9 Rechargeable cells—

(Ever Ready Co., U. K., 1969, 9 pages); Zinc Abs., 28, 134 1970. The principles of operation of the nickel/cadmium cell system are examined, and a description is given of the button, cylindrical and rectangular types of the sealed cells. Charging and the necessary equipment are covered, and some applications of the cells in instruments and appliances are indicated. Tables, figures and illustrations.

10 French electronic car—

(Mass Prod., 46, No, 1, 39, 1970); Zinc Abs., **28**, 134, 1970. A new electric car has been produced in France. It is designed to be powered initially by standard lead – acid or nickel/cadmium batteries, which will eventually be supplemented by recharge thermal motors. The control of the car is by a complex electronic information system and there is neither stearing wheel nor pedals. Strong currents with thyristors are used to drive electronic commutation motors.

11 Charging requirements of automotive propulsion type batteries—

E. E. Moyer (S. A. E. Rept. No. 690130, 1969, 13 pages); Zinc Abs., **28**, 134, 1970. Charging requirements, equipment and procedures are discussed for lead-acid, nickel/cadmium and other types of batteries. Rapid charging, control, circuitry and component devices are considered. Four figures, illustration and an extensive bibliography.

12 High rate primary zinc/air battery—

E. G. Katsoulis and B. Randall (U. S. Govt. Res. Develop. Rept., AD 681 243, 1968, 44 pages); Zinc Abs., **28**, 182, 1970. The battery was designed to meet certain requirements which were satisfied: weight 0.85 lb, energy density 113 Wh/lb and cost of materials $0.017/Wh. Seven tables, 12 figures and 2 illustrations.

13 Application considerations for the new zinc/air battery—

G. Dalin and A. Charkey (Am. Soc. Mech. Engrs Publ. 68-DE-16, 1969, 7 pages); Zinc Abs., **28**, 182,1970 Construction and properties, applications, cost factors, secondary battery maintenance, dry and wet storage; experimental use to power a motor scooter; 7 figures and illustration.

14 Portable power-batteries—

(Eng. Mater Design, **13**, No. 2. 195, 199, 203, 1970). Survey of commercially available battery systems: primary and secondary systems, standard cells, water activated batteries, reserve batteries; latest developments; examples—power source for electric traction and an electric shaver. One table, 10 figures and illustration.

15 Evaluation programme for secondary spacecraft cells. General performance test of General Electric Company 6 ampere-hour nickel/cadmium Cells—

D. E. Mains et al (U. S. Govt. Res. Develop. Rept., AD 679 699, 1968, 29 pages); Zinc Abs., **28**, 183, 1970. The cells were subjected to vibration, mechanical shock and acceleration tests, and their charge and discharge voltage characteristics as well as overcharge behaviour were investigated. The test results are reported, and it is shown that the cells are capable of withstanding the conditions specified. Three tables and 17 figures.

16 Hybrid bus responds to urban pollution—

N. Hunter (Prod. Eng., U.S.A., **40**, No. 23, 12, 1969); Lead Abs., **10**, 72, 1970. An experimental diesel-electric bus has been developed and built by Daimler-Benz in order to eliminate exhaust emissions and to reduce noise. The vehicle can run for 2½ hours on the lead-acid batteries which have an operating capacity of 91 kwh from the 189 cells connected in series to give an output of 380V. It is intended that the bus should run on batteries in city centres and use the diesel generator in less populated areas to drive the motor and to recharge the batteries. One illustration and 2 figures.

17 Hydrogen-permeable membrane—

(British Patent, 1, 179, 033); Platinum Metals Review. **14**, No. 3, 116, 1970. A fuel cell is operated by passing a mixture of hydrocarbon and steam over a reforming catalyst, and passing the hydrogen so formed through a permeable membrane into an electrolyte for electrochemical reaction. The membrane is of palladium or its alloy, e. g., one containing 25 per cent silver.

18 Nickel—cadmium batteries—

M. B. Cotton (Compon. Technol., **4**, No. 2, 13-7, 1969); Electro Technology, **41**, No. 2, xi, 1970. Discussion of the various types, properties and assembly methods; advantages offered and method of charging. They are comparable to nickel-iron cells.

19 Battery chargers—

W. Kiryluk (Electl. Equip., 9, No. 5, 28, 1969); Electro Technology, **14**, No. 2, xii, 1970. Techniques adopted in and facilities offered by the use of thyristors in battery chargers.

20 Battery chargers—

(Electl. Equip., **9**, 5, 45, 1969); Electro Technology, **14**, No. 2, xii, 1970. Survey of battery chargers available in the U. K. for industrial and laboratory applications; definitions of charging terms.

21 Battery charging—

E. J. W. Morrison (Electl. Equip., 9, No. 5, 40-2, 1969); Electro Technology, **14**, No. 2, xii, 1970. Requirements of battery charging systems and methods of meeting them.

22 Sealed nickel-cadmium cylindrical rechargeable single cells. IEC - 285, Part 1: General requirements and test methods—

Also gives rated voltage, rated capacity, charging of rechargeable cells, low temperature performance, conservation of charge, overcharge tests and life test.

23 New designs for zinc/air batteries—

H. R. Knapp (U S. Govt. Res. Develop. Repts., 70 No. 2, AD 697 125; 1970); Zinc Abs., 28 232, 1970. R and D studies for military applications; design and construction features of mechanically rechargeable batteries, and electrical characteristics for various local conditions; performance

data over 0 to 125°F to substantiate the selection of the present designs.

24 Analysis and evaluation of spacecraft battery life test data (phase 2)—

J. R. Kent (U. S. Govt. Res. Develop. Repts., **70**, No. 3, AD 697 938; 1970); Zinc Abs,, **28**, 233, 1970. Mathematical statistical analysis of data derived from life tests performed on 660 nickel–cadmium spacecraft battery cells. The accuracy of predicting the useful life of a cell amounted to 85 per cent.

25 Cycle life testing of vented, rechargeable silver/cadmium cells—

S. Charlip and H. N. Seiger (U. S. Govt. Res. Develop. Repts., 70, No. 2, AD 697 863; 1970); Zinc Abs., **28**, 235, 1970. Test reports of four rated capacities from 7 to 31 ampere–hrs. The cell capacities are given for the 112th manual discharge cycle following 110 automatic and one manual cycle at 62.5 per cent depth of discharge. The automatic cycling programme consisted of 3½ hours of charging and 2½ hours of discharge, and results are given for a total of 1008 cycles.

26 New high temperature fuel cells based on metal-doped salt melts—

R. Bertram, G. Teuber and F. Mommert (Chem. Ing. Tech., 41, 1022, 1969); Zinc Abs., **28**, 236, 1970. The design and operating principles are described of a fuel cell in which the fuel and oxidant are represented by the anionic component and a metal in solution. The systems tested included cadmium/cadmium chloride, and it is shown that melts of halogenides doped with metals show a strong increase of electrical conductivity with increasing metal concentration.

27 Investigations on the direct reduction of zinc oxide in the solid phase—

O. Hladik and K. Schwabe (Electrochim. Acta, 15, 635, 1970). The machanism of reduction of zinc oxide is of great interest with respect to zinc/air battery construction. A study employing electrochemical and radiochemical techniques is reported, and it is shown the reduction of the oxide in direct contact with the cathode occurs in the solid phase. The advantages of the production of zinc powder by the electrolytic reduction of zinc oxide suspended in a neutral salt electrolyte are considered. Seven figures.

28 Evaluation of Ni/Fe and Ni/Zn batteries—

T. W. Blickwedel (U. S. Govt. Res. Develop Repts, **70**, No. 6, AD 840 290; AD 852 691; 1970); Zinc Abs, **28**, 280, 1970. Report of the work on the design and initial evaluation of nickel iron cells in the nickel/cadmium BB616 ( )/U, and nickel/zinc cells in the silver zinc BB462 ( )/U size. Development and evaluation studies, which include an investigation of the effects of cell parameters on output, and data analysis by computerized techniques.

29 Hydrated nickel hydroxide electrode potential sweep experiments—

D. M. MacArthur (J. Electrochem. Soc., 117, 422, 1970). Attention is drawn to the commercial success of the nickel/cadmium battery and the resulting interest in the nickel electrode. Report of potential sweep experiments performed on nickel hydroxide film electrodes in an effort to evaluate the oxidation–reduction mechanism involved. The overall reaction for the hydroxide is presented. The diffusion coefficient for the rate controlling process – assumed to be proton diffusion, was determined. Capacity loss was attributed to the formation of a weak conducting layer during the electrode discharge. Two tables and 7 figures.

30 Steel, alkaline batteries, nickel/cadmium cells for train lighting. Capacities, main dimensions—

(German Standard DIN 40, 759, 1969); Zinc Abs., **28**, 281, 1970. Specifications are presented for the principal dimensions, weight and nominal capacity for 5 hours at 20°C for two types of cell. A diagram of exterior battery construction is given. One table and figure.

31 Bipolar accumulator plate—

F. A. Schneider (French Patent 2,007,392; 1969); Zinc Abs., **28**, 282, 1970. Description of bipolar plates of improved design for use in nickel/zinc batteries. The two parts of the plate are connected back to back over their entire surface and an electrolyte barrier is provided. In an example cited,

a 100 cell battery fitted with the bipolar plates and weighing 479 kg yielded 19,200 Wh at a 5 hr rate of discharge, corresponding to 40 W/kg.

32 Improved zinc electrode and battery containing such an electrode—

(French Patent 2,001,757; 1969); Zinc Abs., **28**, 282, 1970. The battery described contains a rechargeable zinc/zinc oxide electrode which is soluble in the electrolyte. The electrode, which also incorporates a ptfe-based binder, is designed to contain more active material on the edges and periphery than in the centre. Constructional details are presented; 12 figures.

33 Report on the long distance test run of lead-acid battery car—

S. Tokunaga (Japan Lead Zinc Develop. Assoc., 1969, 5 pages); Lead Abs., **10**, 151, 1970 Performance characteristics are tabulated and described for the Yuasa battery car powered by lead-acid batteries during a 1,000 km run. Daily distances together with the subsequent battery charging times are presented together with comments on battery powered cars Two tables and 3 illustrations

34 Lead-acid battery developments—

C. Bushrod (Elec. Rev, 186, 645, 1970). Review of landmarks in historical development; future of the industry in relation to other battery systems and fuel cells is assured; planned improvements in the lead-acid battery; 1 figure and 5 illustrations.

35 Bigger loads and any fuel—

A. Scott (Engineering, 209, 364, 1970). Description of a new range of forklift trucks, designed for longer life, ability to handle larger loads, capacity for attachments, and higher productivity. The battery powered version of the trucks is available in two types, a high performance model with Savcon pulse control system and power assisted stearing equipped with a 48V battery, and a standard model fitted with a 36V battery and conventional carbon pile control; 4 illustrations.

36 Gas recombining system for a sealed secondary battery cell—

(British Patent 1,181400; 1967); Lead Abs,, **10**, 127, 1970 The construction is described of a lead-acid battery cell, in which the oxygen and hydrogen evolved during charging are collected and recombined catalytically to form water which then flows back to the cell; cell design drawings provided.

37 Zinc/dichromate high power primary cell—

G Pistoia and B. Scrosati (J. Electrochem. Soc., 117, 645, 1970) The characteristics and performance of an improved cell are reported. Attention is drawn to the high current and power density values obtainable. One table and 4 figures.

38 Charge acceptance of the cadmium/cadmium hydroxide electrode at low temperatures–

Y. Okinaka and C. M. Whitehurst (J. Electrochem. Soc., 117, 583, 1970). There is a close correlation between the low temperature charge acceptance and the size of the hydroxide crystals in a sealed nickel/cadmium battery. One table, 4 figures and 2 illustrations.

39 Oxidation/reduction mechanism of the cadmium metal/cadmium hydroxide electrode—

Y. Okinaka (J. Electrochem. Soc., **117**, 289, 1970). The process has been investigated with the aid of a rotating ring-disc electrode and a stationary electrode; 8 figures.

40 Power supply set AN/GSQ-152. Engineering evaluation—

L. J. Pilla (U. S. Govt. Res. Develop Repts., 70, No. 8, AD 701 878; 1970); Zinc Abs., 28, 316, 1970. A new static a.c./d.c. portable military power source is described, which provides either 115V, 400 HZ a.c., or 28V d.c The primary power source for the power supply set is a thermoelectric generator operated in parallel with a 5.5 Ah nickel/cadmium battery. The output yields 28V d.c. at 20 amp or a combination of both, at a power level not exceeding the limitations of the primary source.

41 Effect of lead ions on the dissolution and deposition characteristics of a zinc single crystal in 6N KOH—

F. Mansfield and S. Gilman (J. Electrochem. Soc., 117, 588, 1970). The use of alkaline zinc electrodes for several commercial and proposed aqueous battery

devices is discussed briefly ; effect of additives ; 1 figure and 8 illustrations.

42 Use of ultrasonics for the removal of undesirable reaction products from porous sintered electrodes in an aqueous medium—

Z. Dominiczak et al., (Prezemysl Chem., Poland, **49**, 294, 1970): Zinc Abs., **28**, 347, 1970. Report on the use of ultrasonics at 30, 45 and 800 kHz for washing the sintered electrodes after their impregnation for use in nickel/cadmium batteries. The washing time was reduced from 60 to 10 minutes using the 800 kHz frequency and an ultrasonic wave intensity of 1.0 to 1.5 W/cm^2; 5 figures.

43 Improved cathode systems for high energy primary batteries—

M. M. Nicholson (U. S. Govt. Res. Develop. Repts., **70**, No. 11, AD 845 244; 1970); Zinc Abs., **28**, 347, 1970. Report of studies on the influence of the electronic conductivity on the performance of high energy battery cathode systems. Cadmium fluoride was chosen as the model system. The utilization efficiency achieved with yttrium doped and cadmium treated cadmium fluoride discharged in a lithium perchlorate/propylene carbonate electrolyte was considerably higher than that observed for the undoped material.

44 Powdered zinc is key to new battery—

(Metals Week, U. S. A., **41**, No. 19, 5, 1970) ; Zinc Abs., **28**, 348, 1970. Brief description of an instant-starting zinc fuel battery powered cars. It is reported to be highly efficient and econocal. Power of 200W to 20 kw can be obtained, suggesting possible use as a portable power source for many applications.

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