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PROVISIONAL SPECIFICATION.

A PRIMARY WET CELL.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, OLD MILL ROAD, NEW DELHI-1, INDIA, AN INDIAN REGISTERED BODY INCORPORATED UNDER THE REGISTRATION OF SOCIETIES ACT (ACT XXI OF 1860).

THIS IS AN INVENTION BY VEERARAGAVA ARAVAMUTHAN OF THE CENTRAL ELECTRO CHEMICAL RESEARCH INSTITUTE, KARAIKUDI, INDIA, AN INDIAN CITIZEN.

The following specification describes the nature of this invention.

This invention relates to the manufacture of a new primary wet cell.

The invented primary wet cell consists of a two fluid primary porous pot wet cell system wherein ferric chloride is employed as a depolariser.

The two fluid primary porous pot wet cell system comprises the following:

1. A hollow, solid, perforated, grooved or corrugated cylinder or a plate of graphite or carbon with screw terminal with lid fitted to it as positive electrode. One inch diameter and nine inches long solid graphite cylinder dipping to a depth of eight inches in the depolariser or an equal area of other shapes of carbon or graphite is employed.
2. Surrounding this in a porous pot of medium to high porosity made of earthenware, porcelain, microporous rubber and the like diaphragm of 3 to $3\frac{3}{8}''$ internal diameter, $\frac{1}{16}$ to $\frac{1}{8}''$ thick and 8·5 to 9" height, is the liquid depolariser which is a thirty to thirty-five per cent solution of commercial ferric chloride of suitable acidity. 750 to 800 c.c. of the depolariser is used.
3. An arc shaped amalgamated zinc plate of 4·5" width, 9" height and $\frac{1}{16}''$ thick dipping to a depth of 8" or an amalgamated zinc rod of size $\frac{1}{2}$ to $\frac{7}{16}$th inch diameter and 9" height dipping to a depth of about 8" in an electrolyte of commercial sodium chloride of 20-25 per cent. concentration outside the porous pot. 750 to 800 c.c. of the electrolyte is used.
4. External container of glass, plastic, porcelain, ebonite and the like. The cell has a shape and approximate dimensions similar to Bambairite Leclanche No. 1 cells.
5. The negative plate has a lead similar to the zinc rod used in Leclanche cells.

The voltage on no load per cell is 1·5 volts. The new cell can be assembled very quickly. When the cell is exhausted the spent electrolyte and depolariser can be emptied and filled with fresh solution in a few minutes. The replacement of exhausted zinc by fresh anode also takes only a few minutes. For a few seconds when required the cell can be short-circuited without loss of voltage, etc., for further use.

The new cell is an economical source of galvanic current both for intermittent and continuous current drains. It is an efficient and cheap substitute cell for cell when used for telecommunication purposes, for electric bell, buzzer operations, etc., in the place of Leclanche type inert cell NSI. Leclanche dry cell No. 6; Leclanche sac cell containing sac element No. 1; Leclanche porous pot cell of similar size. The life of the new cell is greater. The new cell does not require any attention whatsoever while the Leclanche type of wet cells require periodical cleaning.

The new cell can deliver 40 amp. hours per cell in the useful voltage range 1·2 to 1·0 when discharged at a continuous current drain of 160-130 milliamps. It shows discharge characteristics similar to storage batteries and very costly primary wet cells developed by Germans during World War II such as the Alfred Schmid cell. However the cost of depolariser in this new cell is very low because of the fact that ferric chloride obtained as a by-product in the beneficiation of ilmenite, chromite, ferruginous bauxite, pyrites, chalcopyrites, low grade manganese ores, low grade iron ores or by treating scrap iron with chlorine or a mixture of chlorine and hydrochloric acid by product of the alkali works is employed in the place of costly depolarisers like sodium chlorate and sulphuric acid or alkali dichromate and sulphuric aicd employed in other primary cells showing similar discharge characteristics. The new cells can also be used as a cheap substitute for foreign made costlier alkaline copper oxide and air depolarised cells when used for continuous current drains at constant voltage such as those required for repeater semaphore signal systems in railways.

The new cell is an efficient and cheap substitute cells for cell for Eveready Radio 'A' battery types 720 to 742 manufactured by the National Carbon Company. With sets of two cells connected in parallel and 5 such sets connected in series, it is possible to feed a vacuum type vibrator pack and pulse-shaping transformer net works at 6-V and 300 milliamps to get 90 volts and 14 milliamps very economically in comparison with the Radio 'B' batteries available commercially. In rural areas in India, these cells will be preferred even to storage batteries because of very little care and maintenance needed with the new cells and the ease with which these can be assembled when exhausted as already pointed out.

The use of a primary porous pot wet cell having the aforesaid components in the aforesaid proportions as a substitute for the commercially available primary wet cells for the purposes mentioned above is not so far reported in literature.

The new primary wet cell described above is an efficient and cheap substitute for (1) Leclanche type of dry, inert, porous pot and sac cells, (2) alkaline copper oxide primary wet cells, and (3) alkaline air depolarised primary wet cells for all use in railways and post offices. For battery operated radios, the new cell is an economic source for supplying energy in comparison with other cell systems in use to-day. The new primary wet cell is also an efficient and cheap substitute for Leclanche systems in use to-day for electroplating small articles on a cottage scale such as electro-guilding.

R. BHASKAR PAI,

Patents Officer,

Council of Scientific and Industrial Research.

Dated this 18th day of July, 1956.

COMPLETE SPECIFICATION.

A PRIMARY WET CELL.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, OLD MILL ROAD, NEW DELHI-1, INDIA, AN INDIAN REGISTERED BODY INCORPORATED UNDER THE REGISTRATION OF SOCIETIES ACT (ACT XXI OF 1860).

THIS IS AN INVENTION BY VEERARAGAVA ARAVAMUTHAN OF THE CENTRAL ELECTRO CHEMICAL RESEARCH INSTITUTE, KARAIKUDI, INDIA, AN INDIAN CITIZEN.

The following specification describes and ascertains the nature of this invention and the manner in which it is to be performed.

This invention relates to the manufacture of a two-fluid porous pot primary wet cell.

A primary wet cell usually consists of (*a*) zinc as anode; (*b*) a liquid electrolyte such as a solution of ammonium chloride, caustic soda, or salts or zinc, etc. or dilute sulphuric acid; (c) cathode of copper, graphite etc., (d) solid depolarisers like manganese dioxide, active carbon, cupric oxide or mixtures of metal oxides with or without graphite; or liquid depolarisers like a solution of copper sulphate, metal bichromate and acid, metal chlorate and acid, nitric acid; or combinations of these in different proportions.

The most popular type of two-fluid primary porous pot wet cell system is the Daniell cell. It consists of strips of zinc and copper immersed respectively in a dilute aqueous solution of zinc sulphate containing some sulphuric acid and a saturated solution of copper sulphate, and separated by a porous partition. Another important two-fluid primary porous pot wet cell system is the Grove-Bunsen cell. It contains strong nitric acid as depolariser, dilute sulphuric acid as electrolyte, zinc as the anode and platinum or carbon as the cathode. The third important two-fluid porous pot primary wet cell system is the Fuller-Partz cell. The zinc anode in this system is kept in dilute sulphuric acid electrolyte and a carbon cathode is kept in a solution of chromic acid. The two solutions are separated by a porous cup.

The Daniell cell found applications in isolated telephone exchanges and in military operations, though it was mainly used for laboratory work. The cell cannot be stored for long period of time because of the diffusion of the electrolytes. The voltage of the Daniell cell ranges from 1·07 to 1·014 volts and it gives fairly flat discharge curves under moderate rates of discharge. The e.m.f. of the Grove-Bunsen cell is 1·9 to 2 volts. The cell was used mostly for laboratory purposes. The formation of nitrogen oxide is the most serious drawback of the cell. The Fuller-Partz cell has never come into general use, mostly on account of cost considerations. Hence Daniell cell was the only type of two fluid primary porous pot wet cell system that was used for telecommunication purposes. This was subsequently replaced by the Leclanche type of dry, inert and wet cells for telecommunication purposes. In the Leclanche systems zinc is employed as anode, carbon as cathode, ammonium chloride solution as such or in the form of jelly is employed as electrolyte and a mixture of active forms of manganese dioxide and carbon is employed as depolariser. The open circuit voltage of Leclanche cell is 1·5. It is suited for intermittent current drains only.

The object of the present invention was to develop a new type of two fluid primary porous pot wet cell system, which could be used as an effective and cheap substitute cell for cell for the commercial Leclanche cells in use today for telecommunication purposes. It was decided to produce cells which would not require any maintenance and would serve continuously for more than six months for intermittent current drains as met with in telecommunication circuits. It was also felt that the cells should deliver their full ampere hour capacity in the desired voltage ranges when continuous currents are taken, in order to enhance their usefulness, and to employ them as substitutes for almost all the other types of primary wet cells in use today for signalling, telegraphy, telephony, etc., such as the caustic soda primary cells employing copper oxide or active carbon as depolariser.

After a thorough survey, it was concluded that ferric chloride as a depolariser would be cheaper than all the depolarisers in commercial use like manganese dioxide, active carbon, sodium dichromate and acid, sodium chlorate and acid, etc., as large quantities of ferric chloride are obtained as byproduct in the following metallurgical operations:

(1) Chlorination of bauxite for the production of pure anhydrous aluminium chloride;
(2) Chlorination of ilmenite for the production of pure titanium tetrachloride;
(3) Chlorination of pyrites and chalcopyrites or other mixed sulphide ore for the recovery of sulphur and the respective metals;
(4) Chlorination of chromite for the production of pure chromium chloride; and
(5) Chlorination of low grade manganese ores for upgrading the mineral.

In addition to the above, the low grade iron ores and fines which are unfit for charging into blast furnaces can be chlorinated to obtain ferric chloride.

The utilisation of surplus chlorine of the alkali works with scrap iron for the production of ferric chloride solution and its sale as 35 per cent. solution has been an attractive outlet for chlorine and hence the use of 35 per cent. solution of ferric chloride as a depolariser was investigated. In regard to the electrolyte the cheapest material that one can think of, is common salt in solution.

Hence the crux of the invention lies both in the use of ferric chloride as a cheap and effective depolariser and also the use of cheap common salt as electrolyte.

The invented primary wet cell consists of a two fluid primary porous pot wet cell system wherein ferric chloride is employed as a depolariser.

In the accompanying drawings (*scale 1″=2″*), *Figs. I and II illustrate the sectional and plan views respectively of* the two fluid primary porous pot wet cell system forming the subject of this invention. Fig. I is a section on AA of Fig. II, which is a plan on BB of Fig. I. The system comprises the following:

1. A hollow, solid (it can also be perforated, grooved or corrugated) cylinder 5 (or a plate (not shown) of graphite or carbon) with screw terminal 8 with lid 1 fitted to it is employed as positive electrode. One inch diameter and nine inches long solid graphite cylinder 5 (or an equal area of carbon or graphite) dips to a depth of eight inches in the depolariser 7 (or an equal area of carbon or graphite).

2. A porous pot 4 made of earthenware, porcelain (ordinary unglazed biscuit procelain, which is produced in the first step of ordinary crockery manufacture has been found to be quite suitable for our purposes), microporous rubber of the like diaphragms of 3 to 3⅛″ internal diameter, $\frac{1}{16}$ to ⅛″ thickness and 8½ to 9″ height, surrounds the cathode 5 and contains the liquid depolariser 7 which is a thirty to thirty-five per cent. solution of commercial ferric chloride. 750 to 800 cc of the depolariser are used.

3. An arc shaped amalgamated zinc plate 3 of 4·5″ width, 8″ to 9″ height and $\frac{1}{16}$″ thickness dips to a depth of 8″ (or an amalgamated zinc rod (not shown) of size ½ to $\frac{7}{16}$ the inch diameter and 9″ height dipping to a depth of about 8″) in an electrolyte 6 of commercial sodium chloride of 20—25% concentration outside the porous pot 4. 750 to 800 cc of the electrolyte is used.

4. External container 2 if of glass, plastic, porcelain ebonite and the like with lid 1. The cell 9 has a shape and approximate dimensions similar to Bambairite Leclanche No. 1 cells.

The negative plate 3 has a lead 10 similar to the arrangement used with zinc rods in Leclanche wet cells.

The voltage on no load per cell is 1.5 volts. The invented cell 9 can be assembled very quickly. When the cell in exhausted the spent electrolyte and depolariser can be emptied and replaced with fresh solutions in a few minutes. The replacement of exhausted zinc by fresh anode also takes only a few minutes. For a few seconds when required the cell can be short-circuited without loss of voltage, etc., for further use.

The new cell is an economical source of glavanic current both for intermittent and continuous current drains. It is an efficient and cheap substitute, cell for cell, when used for telecommunication purposes, for electric bell, buzzer operations, etc., in the place of Leclanche type inert cell NSI, Leclanche dry cell No. 6, Leclanche sac cell containing sac element No. 1, and Leclanche porous pot cell of similar size. The life of the new cell is greater. The new cell does not require any attention whatsoever while the Leclanche type of wet cells require periodical cleaning.

The invented cell can deliver 40 amp. hours per cell in the useful voltage range 1·2 to 1·0 when discharged at a continuous current drain of 160-130 milliamps. It shows discharge characteristics similar to those of storage batteries and the expensive types of primary wet cells developed by the Germans during World War II, such as the Alfred Schmid cell. However the cost of depolariser in this new cell is very low because of the fact that byeproduct ferric chloride is employed in the place of costly depolarisers like sodium chlorate and sulphuric acid or alkali dichromate and sulphuric acid employed in other primary cells possessing similar discharge characteristics. The invented cells can also be used as a cheap substitute for foreign made costlier alkaline copper oxide and air depolarised cells when used for continuous current drains at constant voltage, as for example, in repeater semaphore signal systems in railways.

Two field trials have been conducted by the postal authorities substituting the invented cells (cell for cell) for the Leclanche type cells for telecommunication purposes. These cells have served without any difficulty for well over 11 months whereas the average life of the Leclanche cells under such conditions was only 6 months. Tests conducted by the railway authorities with the invented cells each of 40 amp. hour capacity as a source of continuous current in the place of the wellknown 500 amp. hour capacity copper oxide cells have confirmed that the invented cells require no maintenance and have also shown that in proportion to their ampere hour capacity they serve longer and at a lower cost than the copper oxide cell.

The invented cell is an efficient and cheap substitute, cell for cell, for Radio 'A' dry cells now in common use in battery operated radio sets. With sets of two cells connected in parallel and 5 such sets connected in series, it is possible to feed a vacuum type vibrator pack and pulse-shaping transformer net works at 6-V and 300 milliamps to get 90 volts and 14 milliamps very economically in comparison with the Radio 'B' batteries available commercially. In rural areas in India, these cells may be preferred even to storage batteries because they need very little care and maintenance and can be easily assembled when exhausted as already pointed out.

The use of a primary porous pot wet cell having th aforesaid components in the aforesaid proportions as a substitute for the commercially available primary wet cells for the purposes mentioned above has not so far been reported in the literature.

The above description refers to the optimum conditions with respect to the size of the anode, cathode and volumes and concentrations of electrolyte and depolariser for cells intended to be used as substitute for the commercially available primary wet, dry and inert cells. The invented primary wet cell could be made in different, smaller sizes for use as substitutes for similar sizes of the other primary wet cells. Instead of employing one piece of zinc plate or rod as anode, scrap zinc bound together or compressed or packed tightly around a graphite rod (anode pick-up) to a suitable volume inside a porous pot containing also the sodium chloride electrolyte can also be used as anode cell assembly. The concentration of the sodium chloride electrolyte and its volume are not very critical. The strength of the depolariser for economic working must be at or above 27 per cent. The size of the graphite cathode can also be varied very widely without seriously affecting the performance of the cell. The use of a saturated solution of sodium chloride as such as electrolyte in a two fluid parimary porous pot wet cell system with ferric chloride as depolariser and carbon as cathode having very good shelf life (a statement supported by reports of the field trials conducted by the postal authorities for over eleven months referred to earlier) is the essential novel feature of the invention.

We claim:

1. A primary wet cell which consists of a two fluid primary porous pot wet cell system wherein ferric chloride is employed as a depolariser.
2. A two-fluid porous pot primary wet cell as claimed in Claim 1 wherein a saturated solution of sodium chloride is used as electrolyte.
3. A two-fluid porous pot primary wet cell as claimed in Claim 1 or 2 wherein carbon is employed as cathode.
4. A two-fluid porous pot primary wet cell as claimed in any of the proceeding claims wherein zinc plate or rod or scrap zinc bound together or compressed or packed tightly around a graphite rod (anode pick-up) inside a porous pot containing sodium chloride electrolyte is used as anode cell assembly.
5. A two-fluid porous pot primary wet cell as claimed in any of the preceding claims wherein the strength of the depolariser is at or above 27 per cent.
6. A two-fluid porous pot primary wet cell substantially as hereinbefore described.

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Dated this 18th day of April 1957.

MGIPC—S5—59 Patent/57—23-7-58—100.

COUNCIL OF SCIENTIFIC

INDUSTRIAL RESEARCH

NO. 57958.

ONE SHEET

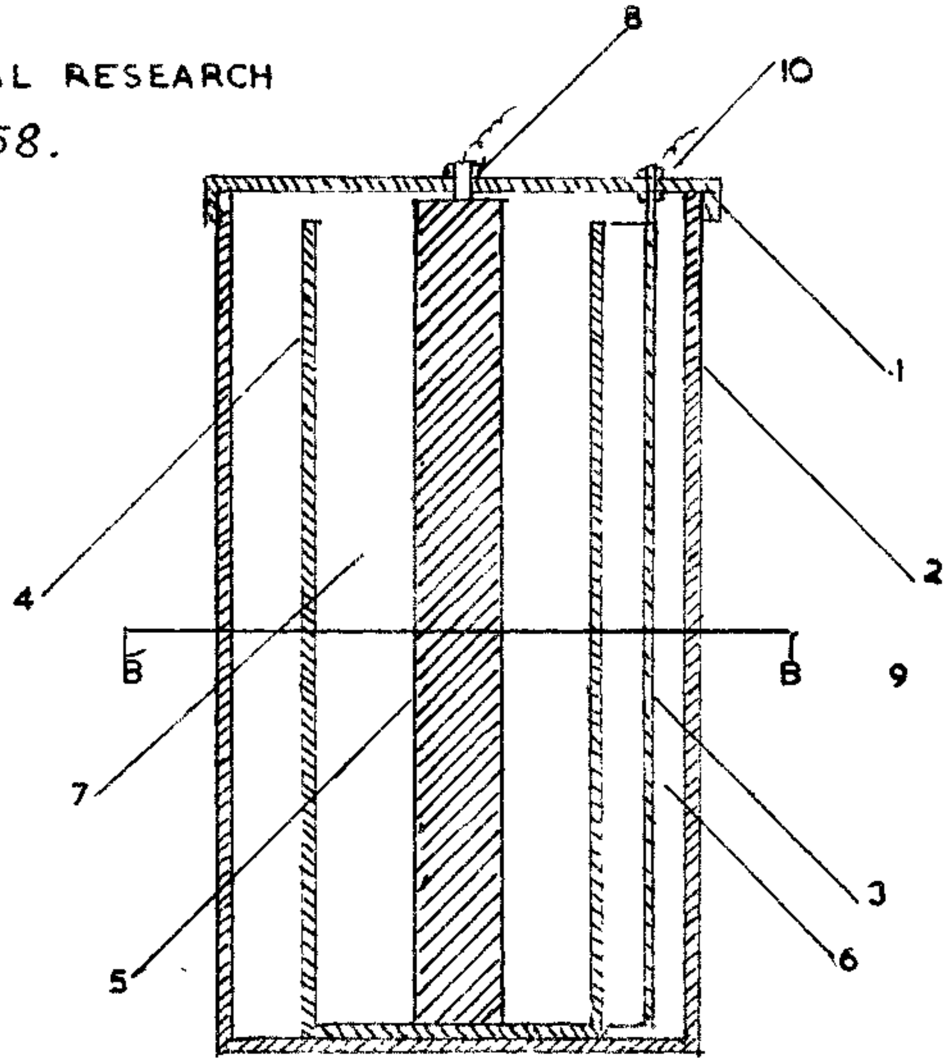

FIG I

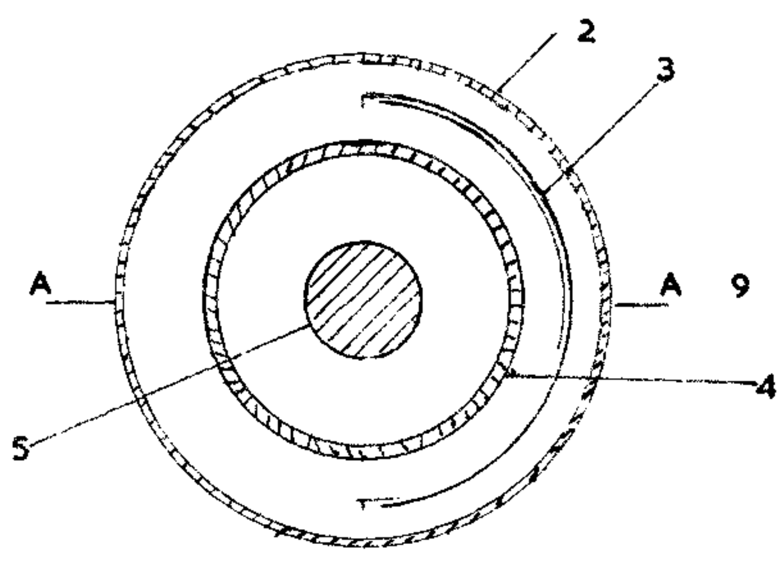

FIG II

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