Intellectual Property Office

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20 August 2013

PATENTS ACT 1977

APPLICANTS Gareth Glass, Adrian Roberts & Nigel Davison

ISSUE Whether patent application GB 1009825.9 complies with the requirements of sections 2 and 76 of the Patents Act 1977

HEARING OFFICER Phil Thorpe

DECISION

1 Patent application GB 1009825.9 was filed on 14th June 2010 by Mr Gareth Kevin Glass, Mr Adrian Charles Roberts & Mr Nigel Davison. Mr Glass is the only named inventor. The application has a claimed priority of 15 June 2009. The application was published as GB 2471184 on 22nd December 2010.

2 The applicants have been unable to satisfy the examiner, Miss Elizabeth Price, that the claimed invention is novel over WO 2005/106076 and whether amendments to the claims have disclosed matter extending beyond that disclosed in the application as filed. The matter subsequently came before me at a hearing on 17th June 20133 attended by all three applicants and the examiner Ms Elizabeth Price.

The invention

3 The invention relates to electrochemical protection of steel in reinforced concrete exposed to the air. More specifically it relates to the use of sacrificial anodes and in particular to the use of distributed discrete sacrificial anode assemblies in arresting steel corrosion in corrosion damaged concrete elements.

4 The description sets out the background to the invention and the problems that the invention seeks to overcome. According to the description electrochemical treatments may be classed as either impressed current or galvanic (sacrificial) treatments. In galvanic electrochemical treatments, the protection current is provided by one or more sacrificial anodes that are directly connected to the steel. Sacrificial anodes are electrodes comprising metals less noble than steel with the main anodic reaction being the dissolution of a sacrificial metal element. The natural potential difference between the sacrificial anode and the steel drives a protection current when the sacrificial anode is connected to the steel. The protection current flows as ions from the sacrificial anode into the parent concrete to the steel, and returns as electrons through the steel and a conductor to the sacrificial anode. Sacrificial anodes for concrete structures may be divided into discrete or continuous anodes.

Discrete anodes are individually distinct elements that contact a concrete surface area that is substantially smaller than the surface area of the concrete covering the protected steel. The anode elements are normally connected to each other through a conductor that is not intended to be a sacrificial anode and are normally embedded within cavities in the concrete. Discrete sacrificial anode systems include an anode, a supporting electrolyte and a backfill. An activating agent is often included to maintain sacrificial anode activity. The backfill provides space to accommodate the products of anodic dissolution and prevent disruption of the surrounding hardened concrete. Discrete sacrificial anodes have the advantage that it is relatively easy to achieve a durable attachment between the anode and the concrete structure by embedding the anodes within cavities formed in the concrete.

5 Galvanic protection of steel in concrete using embedded discrete anodes differs from sacrificial cathodic protection of steel in soils and waters. Anode assemblies that are embedded within concrete must be dimensionally stable as concrete is a rigid material that does not tolerate embedded expanding assemblies. Anode activating agents are specific to concrete or need to be arranged in a way that would present no corrosion risk to the neighbouring steel. Anodes are located relatively close to steel in concrete and embedded anodes are small (a discrete anode assembly diameter is typically less than 50mm) when compared to anodes in other environments. Galvanic protection criteria for atmospherically exposed concrete differ from those for the cathodic protection of steel in soils and waters. Steel is normally passive in uncontaminated, alkaline concrete. In atmospherically exposed concrete, protection is usually achieved by restoring the passive film on reinforcing steel. This effectively polarises the anodic reactions on the steel.

6 One problem with the use of sacrificial anodes in galvanic treatments is that the power to arrest an active corrosion process on steel in concrete is limited by the voltage difference between the sacrificial anode and the steel. This problem is greatest for discrete sacrificial anode systems where large currents are required from relatively small anodes to protect relatively large surfaces of steel. A compact discrete anode will typically deliver current into an area of parent concrete adjacent to the anode that is one tenth to one fiftieth of the area of the steel it is expected to protect.

7 Another problem with discrete sacrificial anode systems is current distribution. This problem is greatest for anodes that are tied on to exposed steel in cavities formed within the concrete at areas of concrete repair. A number of solutions have been proposed to improve the current distribution from an anode tied to the steel. However these solutions are all based on restricting the current flow to the nearest steel by increasing the resistance for current to flow to the nearest steel.

8 The problem to be solved by this invention is to increase the power available from a sacrificial anode assembly to arrest an active corrosion process while the sacrificial anode is connected to the steel in the concrete, and to improve current distribution from a sacrificial anode connected to the steel by directing an increased current away from the nearest steel. This is achieved by using additional anode-cathode assembly to modify the electric field in the environment next to the anode while the sacrificial anode is connected to steel with an electron conducting conductor.

9 The effect of the modifier is illustrated in Figure 1 of the application (shown below).

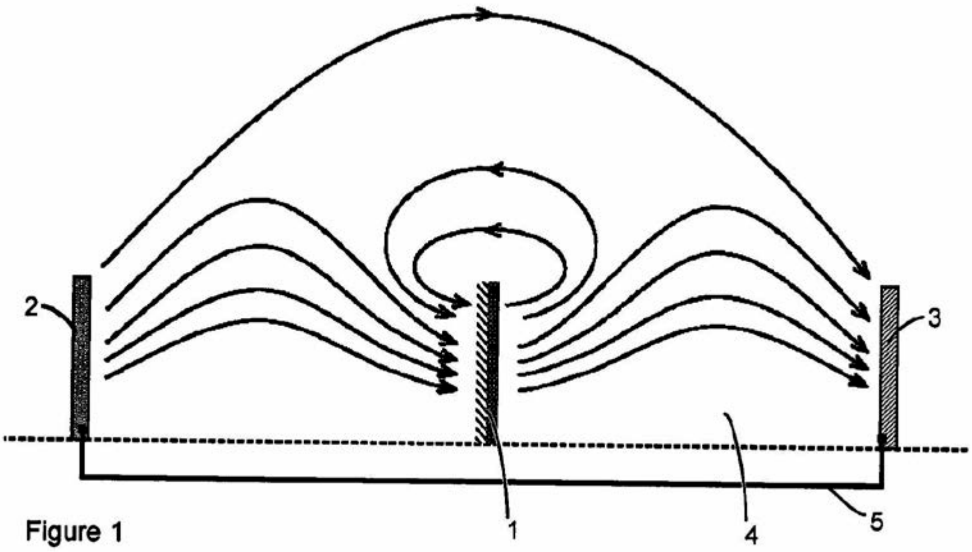

Figure 1

10 The modifier 1 acts like an electric current pump. The electrochemical reactions on its electrode surfaces drive electrons (current) on its inside from its cathode electrode to its anode electrode. This may be used to change the ionic current in the electrolyte outside the modifier. It is to be appreciated that the modifier 1 may be used to increase the flow of external current, change the direction of the external current or even reverse the direction of the external current.

11 The modifier 1 is placed between the sacrificial anode 2 and the protected steel 3 in an electrolyte 4. The anode 2 is electrically connected to the steel through a connector 5. A galvanic protection current that flows from the sacrificial anode 2 through the electrolyte 4 to the steel 3 returns to the sacrificial anode 2 via the connection 5. In one embodiment the modifier 1 has a surface facing the sacrificial anode 2 that acts as a cathode and a surface facing the steel 3 that acts as an anode and a natural potential difference between the anode and cathode stimulates reactions on the anode and cathode. The anode and cathode electrodes of the modifier 1 are connected back to back by an electron conducting connection and face in opposite directions.

12 The construction of the modifier is preferably shown in figure 2. A cavity 8 which is a drilled or cored hole in the concrete 9 typically be no more than 50 mm in diameter contains a sacrificial anode 10 in the form of a bar. The will typically be no more than 200 mm in length and be cast around a conductor. The sacrificial anode 10 is connected to the steel 11 with a conductor 12 (typically an electric cable or wire). The modifier 13 comprising an anode 14 and a cathode 15 in the form of a tube or hollow cylinder that is open at both ends and which substantially surrounds the sacrificial anode 10. The cathode may be an air cathode and oxygen from the air may diffuse into the tube through either of its openings. A filler 16 provides an electrolyte that is an ionic conductor to connect the sacrificial anode to the cathode of the modifier. The filler will preferably be in the form of a porous solid or putty containing the electrolyte.

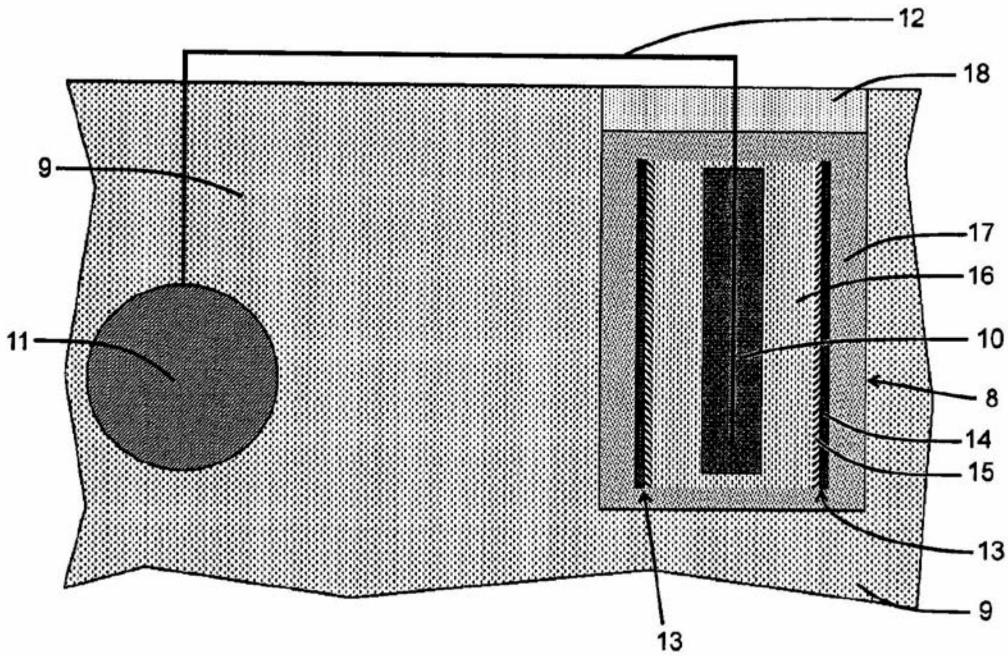

Figure 2

13 The latest claims are those filed on 9th July 2012. These comprise independent claim 1 together with a number of further dependent apparatus and method claims. There is also an omnibus claim. The independent claim reads as follows:

Claim 1

A sacrificial anode reinforced concrete protection assembly for protecting steel in hardened reinforced concrete elements exposed to the air, the assembly comprising a sacrificial anode for reinforced concrete elements and an electric field modifier wherein:

the sacrificial anode:

comprises a metal less noble than steel;

comprises a connector for electronic connection of the sacrificial anode to steel in a reinforced concrete element; and

is at least in part surrounded by the electric field modifier; and

the modifier comprises an element having an anode side in electronic contact with a cathode side wherein;

the anode side comprises an anode adapted to support an oxidation reaction, which anode faces away from the cathode side and

the cathode side comprises a cathode adapted to support a reduction reaction;

and the modifier is separated from the sacrificial anode

The prior art

14 The examiner has maintained throughout the examination of the application that the claims lack novelty in the light of the disclosure in WO2005/106076 (hereinafter referred to as FOSROC). With reference to figures 1a and 1b of FOSROC6 (reproduced below) this document teaches a sacrificial anode assembly 1 for cathodically protecting a metal section in reinforced concrete. The assembly comprises a cell, which has an anode 2 and a cathode 3. The cathode 3 is a manganese dioxide/carbon mixture and is in the shape of a can, having a circular base and a wall extending upwards from the circumference of the base, so as to define a cavity. The anode 2 is a solid zinc anode of cylindrical shape, with the solid zinc being cast metal, compressed powder, fibres or foil. The anode 2 is located centrally within the cavity defined by the can shaped cathode 3 and is in contact with electrolyte 4 present in the cavity defined by the can shaped cathode 3, which maintains the activity of the anode. The electrolyte 4 is suitably potassium hydroxide, and may contain other agents such as zinc oxide to inhibit hydrogen discharge from the zinc. A porous separator 5, which is can shaped, is located inside the cavity 3a defined by the cathode 3, adjacent to the cathode 3. Accordingly, anode 2 and cathode 3 are not in electronic contact with each other, but are ionically connected via the electrolyte 4 and porous separator 5 such that current can flow between the anode 2 and the cathode 3.

15 The anode 2 is attached to a connector 6 for electrically connecting the anode 2 to the metal section to be cathodically protected. The connector 6 is suitably galvanised steel. The cathode 3 of the cell is electrically connected in series with a sacrificial anode 7. Sacrificial anode 7 is solid zinc and is can shaped, with the solid zinc being cast metal, compressed powder, fibres or foil. The cell is located inside the cavity defined by the can shaped sacrificial anode 7.

16 The objective of the invention is to boost the voltage between the sacrificial anode and the metal section such that it is greater than the natural potential difference that exists between the metal section and the material of the sacrificial anode. This is achieved by connecting the sacrificial anode in series with a cell which can be a standard AA battery. The addition of the cell also provides a high initial current which can be useful as it allows the assembly to be used to passivate metals, such as steel, which metals may be in an active corrosion state or may be in new concrete.

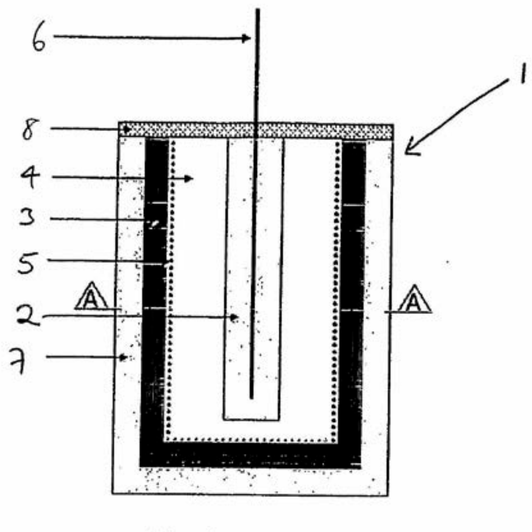

Fig 1a

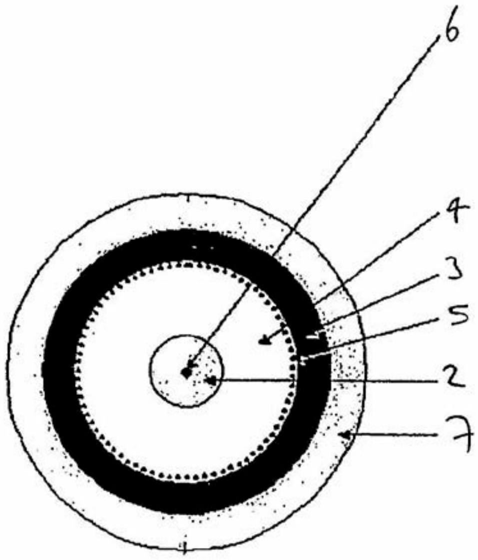

Fig 1b

17 According to the description the cell may be any conventional electrochemical cell. In particular, the cell may comprise an anode which is any suitable material and a cathode which is any suitable material, provided of course that the anode has a more negative standard electrode potential than the cathode. Suitable materials for the anode include metals such as zinc, aluminium, cadmium, lithium and magnesium and alloys such as zinc alloys, aluminium alloys, cadmium alloys and magnesium alloys.The anode and the cathode may each be provided in any suitable form, and may be provided in the same form or in different forms, for example they may each be provided as a solid element, such as in the form of a cast metal/alloy, compressed powder, fibres or foil, or may be provided in loose powdered form.

Argument

18 The applicants accept that the arrangements disclosed in FOSROC have many of the features of the invention set out in the claim of their application. Indeed they accept that FOSROC discloses all the features of claim 1 except for one important exception. What FOSROC does not disclose or suggest is the presence of an anode that is “sacrificial anode for reinforced concrete” as that term would be understood in the art and as it would be construed from the patent application. Rather they argue that the anode 2 that is electrically connected to the steel via conductor 6 in FOSROC is an anode of a cell rather than a sacrificial anode

19 The majority of the hearing was unsurprisingly devoted to discussing this point. According to the applicants, the term “sacrificial anode for reinforced concrete” has a particular meaning in the art. To support their position the applicants have submitted a number of documents as evidence. These include a copy of British Standard BS 12696 2000 and a Glossary of Terms taken from a technical report entitled Cathodic Protection of Steel in Concrete produced by a working party of the Concrete Society, the Corrosion Protection Association and the Institute of Corrosion[1]. I allowed the latter to be submitted shortly after the hearing.

20 I will discuss the British Standard first. The applicants specifically refer me to Note 3 of section 10.1 which discusses the duration that any system should ideally provide protection for. The applicants, who were also the named inventors on the FOSROC patent, argue that the prototype of the system set out in FOSROC only provided cathodic protection for 3 months and then failed. This would therefore apparently not meet the requirements in the British Standard. Having read the Standard a couple of times I am not however convinced that it teaches that an anode can only be considered as a sacrificial anode for reinforced concrete if it provides a certain duration of protection. There may well be anodes that provide a shorter duration of protection such that they don’t meet the standard but yet would still be considered suitable for reinforced concrete protection.

21 I also did not find the glossary of terms especially helpful. The entry under “sacrificial anode” refers simply to “See Galvanic anode”. The entry under that header does not really add anything that appears relevant to the question before me.

22 The applicants have also each provided a signed witness statement. Each of these includes the following;

> “I do not consider the cell anode disclosed in FOSROC to be a sacrificial anode for reinforced concrete elements. Furthermore it is my belief that adapting a cell anode to be a sacrificial anode for reinforced concrete elements would be inventive. An example of such an invention is provided by the alkaline sacrificial anode for reinforced concrete elements claimed in claim 18 in patent EP0707667 (B1) entitled “CATHODIC PROTECTION OF REINFORCED CONCRETE” which is novel and inventive despite the presence of alkaline cell anodes in the prior art”

[1] Technical Report No. 73 2011

23 The applicants also argue the sacrificial anode in their invention is adapted to deliver ionic current to the steel in the concrete where it is converted back to electronic current. The cell in FOSROC in contrast is adapted for the delivery of ionic current into the cell electrolyte and to the cell cathode where it is converted back to electronic current. I make two points on that. The first is that the claim is not clearly limited in this respect. The second is that the applicants have not shown that to my satisfaction that the nature of the ionic and electrical current paths is necessary a defining feature of sacrificial anodes for reinforced concrete.

24 Notwithstanding my reservations about some of the arguments advanced by the applicants, I have however come to the conclusion that on balance FOSROC does not disclose nor suggest the invention claimed. In particular I am satisfied that the skilled person would not construe the cell anode in FOSROC to be a sacrificial anode in the sense that he would understand the drafters of the application in issue to have used that term. Rather he would recognise the anode 7 in FOSROC to be the sacrificial anode with anode 2 being simply a cell anode.

25 The applicants have put forward some alternative wording for the claim which in their view further distinguishes their claim from FOSORC. I will leave it to the applicants to decide whether to formally submit this as an amendment to the claim although as I indicated above, I am satisfied that the claim as it currently stands is distinguished from FOSROC.

26 I should add for completeness that in the course of the hearing the examiner indicated that if I found the claim to be distinguished then there would be no question of any inventive step argument arising from FOSROC. I think the examiner is right on that.

Other objections to the claims

27 The examiner has also objected that the amended claims add matter to the application as originally filed. In particular the examiner objected to the removal from the claim of the requirements that the anode of the anode side of the modifier faces away from the sacrificial anode and that the cathode of the cathode side of the modifier faces and is separated from the sacrificial anode by an ionically conductive filler. According to the examiner it is not clear how an arrangement other than what was originally claimed would provide the necessary cathodic protection for the steel in reinforced concrete.

28 Mr Glass responds firstly that the application as filed in paragraph 38 talks about the modifier being used to increase the flow of external current, to change the direction of external current or even reverse the direction of the external current. This he argues would be understood by the skilled person to mean that the cathode and anode of the modifier could be turned around by 180 degrees. He refers also to the two specific examples given in the description at paragraphs 72 and 76 both of which refer to a test wherein the modifier is reversed so as to effect the current flowing from the sacrificial anode.

29 I am satisfied on the basis of these arguments that the amendment is supported by the application as originally filed.

Conclusion

30 I find the invention claimed in the claims filed on 9th July 2012 to be new and inventive having regard to WO 2005/106076. I also find that that the amendment that removes the requirement that the anode and cathode face a particular direction with respect to the sacrificial anode is supported by the application as filed and hence does not add matter contrary to section 76(2).

31 I therefore remit the application to the examiner.

Appeal

32 Any appeal must be lodged within 28 days

Phil Thorpe