Filled metal cans, of aluminium or tinplate, are prone to secondary corrosion from outside, particularly around the rim of their bases. According to the invention, the exterior surface of this rim carries a coating of a non-toxic hydrophobic oily, greasy or waxy substance such as petrolatum, cetyl alcohol, or a silicone.
FILLED METAL CANS

This invention is concerned with filled metal cans, typically of tin plate or aluminium, of the kind where a lid is sealed to the side walls so that the contents are protected from external attack. Such cans are very widely used for the storage and transport of foods and beverages. Inevitably, a small proportion of such cans leak as a result of handling damage. This invention is concerned with the problem of secondary corrosion attack on adjacent cans by fluid which has escaped from these "primary leakers". Thus, unlike primary corrosion, secondary corrosive attack starts at the outside of the can.

Beverage cans, whether of steel or aluminium, require an internal coating of protective lacquer to prevent interaction between the beverage and the unprotected metal. In practice, a single-stage coating of high integrity can be readily applied to aluminium, whereas two coats are generally required on steel.

In addition to the internal protection, it is also necessary to protect the entire outer surface of steel cans to avoid atmospheric corrosion (rust). Aluminium, on the other hand, requires no such protection because the body-stock alloy, due to the presence of its natural oxide film, is highly resistant to normal damp conditions. Only the riding edge of the can, the base rim, is normally coated, primarily as an aid to mobility during both manufacture and filling.

With aluminium cans under certain conditions a form of localised "secondary" corrosion can occur. This is the result of primary leakage from one can, almost always the result of mechanical damage, allowing the contents to attack and sometimes perforate the exposed external surface of adjacent cans. If the leaking can is at the top of a stack of cartons, a "chain reaction" can follow which may affect thousands of cans in a relatively short time scale.

Steel cans suffer in a similar way. Although perforation will generally take longer, the formation of rust will quickly render the cans cosmetically unsaleable. These problems have existed ever since cans were first used as containers for food and beverages, i.e. about sixteen years for aluminium and longer for steel. One major UK filler of aluminium beverage cans reckons to lose very roughly one can per thousand, i.e. several hundred thousand cans per year, to secondary corrosion.

In Verpackungs-Rundschau, 5/1977, p652, G. Windaus et al describe spectacular secondary corrosion damage to beer cans, both steel and aluminium, exported to the Middle East.

A typical aluminium beverage can has a base comprising a domed concave central region and a surrounding rib comprising a riding edge, which contacts the surface on which the can stands, and an inclined chine which joins the riding edge to the side wall. It is primarily in the region of this rim that secondary corrosion occurs. Previous attempts to reduce the problem have been mainly in two directions:

a) After the can has been drawn and drawing lubricant removed, the can is given a zirconium containing pretreatment such as Alodine 404 (TM of Amchem Products inc.) both internally and externally which acts as a sound key for subsequent organic coatings. Lacquer is applied to the interior surface of the can, and also to the riding edge/chine region of the exterior surface. The purpose of this external lacquer is mainly to improve can mobility on the production line. The idea of reducing corrosion by applying several coats of lacquer to the riding edge/chine region has been tried but has not proved very effective. Abrasion resulting from contact with conveyor systems etc. can remove the pretreatment layer prior to lacquering, in which case lacquer will not adhere to the underlying metal; or abrasion may remove a thick lacquer coating as easily as a thin one.

b) The galvanic behaviour of aluminium alloys is well established, and is indeed discussed in detail in "Aluminium and Aluminium Alloys in the Food Industry", Department of Scientific and Industrial Research, Special Report Number 50, HMSO 1948. It is known that contamination of aluminium surfaces with more noble metals, particularly copper or iron, can greatly accelerate corrosion. It is good practice to avoid, as far as possible, contact between can and copper-bearing materials, especially dead-plates in conveyor systems. On mixed filling lines (i.e. lines used to fill both aluminium and steel cans) it is good practice to remove, so far as possible, iron/tin debris, especially at the de-palletiser and can seamer. But in production systems handling six hundred to one thousand cans per minute, it is difficult to avoid abrasion and to avoid contact between aluminium and other metals.

This invention adopts a quite different approach, and provides in one aspect a filled metal can having a base including a rim, wherein the rim carries on its exterior surface a coating of a non-toxic hydrophobic oily, greasy or waxy substance. The use of oily, greasy and waxy substances to prevent corrosion in other situations is, of course, well known. But the application of such substances to the outside of filled cans goes completely
against the conventional wisdom of the canning industry, which has always been to present to the customer a clean attractive can exterior with no risk of contaminating the contents.

Although the filling in the can is not material to the invention, the secondary corrosion problem is mainly confined to food, and particularly, beverage cans. The secondary corrosion problem exists with steel, but is of particular importance when the metal is aluminium, which term is used to cover alloys containing major proportions of aluminium, particularly those conventionally used for can stock.

The oily, greasy or waxy substance may accidentally come in contact with the contents of the can, and therefore needs to be non-toxic to FDA standards at least when the contents are food or beverage. The substance needs to be hydrophobic in order to protect the metal surface from physical contact with the corrosive fluid. The substance is not one which forms a coherent peelable film. It may advantageously have fluid characteristics sufficient to permit the easy formation of a continuous coating. But its viscosity should be so high that it does not significantly trickle or drip off the can under the influence of gravity. Preferably the substance is colourless and transparent or translucent. The substance may be a mineral, vegetable or animal oil or fat, for example a material listed in Martindale. The Extra Pharmacopoeia, under the heading "Paraffins and similar bases". Substances which are approved for use in contact with food stuffs and are preferred for use in the present invention, include petrolatum, a mixture of aliphatic hydrocarbons; cetyl alcohol; and silicones such as that sold by Dow Corning under the trademark Molykote. These materials provide the required barrier properties, are stable, non-staining, have good load supporting characteristics and are solid or semi-solid at ambient temperatures of 20 - 25°C.

The oily, greasy or waxy substance is applied to the rim of the base of the can, or particularly in the case of aluminium cans to the riding edge and surrounding chine. The substance can be applied, either on bare metal or an oxide film in the case of aluminium), or over a lacquer. The amount of substance applied is preferably minimised, both by limiting the area of application and by limiting the rate of application to the chosen area. Application rates are not very critical, and may suitably be of the order of a few grams per square meter of metal surface.

After food and beverage cans have been filled and if necessary sterilised, they are packed in cartons for storage and transport. Particularly in the case of beverage cans, a carton comprises a single layer of cans positioned side by side on a packaging base and a thermoplastic shrink-wrap film surrounding the whole. The packaging base is typically a low-cost cardboard, which may sometimes be waxed in order to reduce liquid penetration. The coating of oily, greasy or waxy substance is preferably applied to the filled cans as the last step before packaging into cartons. In another aspect, the invention includes cartons comprising a number of filled metal cans packaged together, in which each can is protected as described above.

The accompanying drawing is a graph of pitting frequency against exposure time.

EXAMPLE 1

Aluminium cans either uncoated or coated with a thin layer of lubricant (Molykote 111 or Petrolatum i.e. Vaseline) were stood in a packaging carton which was soaked with a cola based product. The packages were held at room temperature and soaked periodically with the cola based product over a period of 120 days.

At intervals of about 1 month the cans were removed and examined for corrosion sites. The type of attack and the depth of corrosion pits was recorded.

The graph shows that the coated cans have fewer corrosion sites than the uncoated control.

What corrosion there is on the coated cans does not penetrate as deeply into the metal as in the uncoated cans.

EXAMPLE 2

A sample of bodystock alloy of nominal composition 0.18% Fe, 0.40% Si, 0.13% Cu, 1.1% Mn, 1.0% Mg, balance Al was provided with a copper insert and pressed on a sheet of packaging material which in turn rested on a sponge kept saturated with a cola based beverage. The time to perforation was 168 hours for an uncoated control, compared to 504 hours for a sample coated with Molykote silicone on its under-side.

EXAMPLE 3

Tin plate beverage cans were taken from a commercial filling line after filling. The riding edge showed signs of abrasion by contact with the conveyer system.

One half of the base of each can was coated with petrolatum and cans stood, base down, on packing card soaked with water. To reveal rusting more clearly, a white filter paper was placed under each can.

After 24 hours rust stains were evident on the
There were no stains on the coated part. Longer exposure leads to more pronounced attack and would eventually cause leakage.

**Claims**

1. A filled metal can having a base including a rim, wherein the rim carries on its exterior surface a coating of a non-toxic hydrophobic oily, greasy or waxy substance.
2. A can as claimed in claim 1 which is filled with beverage.
3. A can as claimed in claim 1 or claim 2, wherein the metal is tinplate.
4. A can as claimed in claim 1 or claim 2, wherein the metal is aluminium.
5. A can as claimed in claim 4, wherein the rim comprises a riding edge and a surrounding chine which both carry the coating.
6. A can as claimed in any one of claims 1 to 5, wherein the substance is colourless and translucent or transparent.
7. A can as claimed in any one of claims 1 to 6, wherein the substance is petrolatum.
8. A can as claimed in any one of claims 1 to 6, wherein the substance is a silicone.
9. A carton comprising a number of filled metal cans according to any one of claims 1 to 8 packaged together.
10. A carton as claimed in claim 9 comprising a single layer of cans positioned side by side on a packaging base and a thermoplastic shrink-wrap film surrounding the whole.
### DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document with indication, where appropriate, of relevant passages</th>
<th>Relevant to claim</th>
<th>CLASSIFICATION OF THE APPLICATION (Int. Cl.4)</th>
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<tr>
<td>X</td>
<td>US-A-2 117 180 (KRONQUEST) * Figure 3; page 1, column 2, line 37; page 2, column 1, line 15 *</td>
<td>1-3,7</td>
<td>B 65 D 23/02</td>
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<td>X</td>
<td>FR-A- 859 987 (CROWN CORK &amp; SEAL CO.) * Figures 1,2; page 1, lines 1-4,31,32; page 3, lines 18-20; page 4, lines 11-14 *</td>
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<td>US-A-2 124 823 (KRONQUEST) * Figures 1,3; page 1, column 1, lines 42-45; page 1, column 2, lines 24-32 *</td>
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<tr>
<td>A</td>
<td>BE-A- 502 881 (PREMO PHARMACEUTICAL LABORATORIES INC.) * Figures; page 4, lines 19-25 *</td>
<td>6,8</td>
<td></td>
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<tr>
<td>A</td>
<td>US-A-4 289 236 (GANZ et al.) * Figure 2; column 2, lines 21,22 *</td>
<td>10</td>
<td>B 65 D</td>
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The present search report has been drawn up for all claims.

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<tr>
<td>THE HAGUE</td>
<td>15-09-1989</td>
<td>STEEGMAN R.</td>
</tr>
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</table>

**CATEGORY OF CITED DOCUMENTS**

- **X**: particularly relevant if taken alone
- **Y**: particularly relevant if combined with another document of the same category
- **A**: technological background
- **O**: non-written disclosure
- **P**: intermediate document

**TECHNICAL FIELDS SEARCHED (Int. Cl.4)**

- **B 65 D**