June 25, 1957 R. W. KAERCHER ET AL 2,797,023

CONTAINER

Filed Oct. 11, 1954

FIG. 1

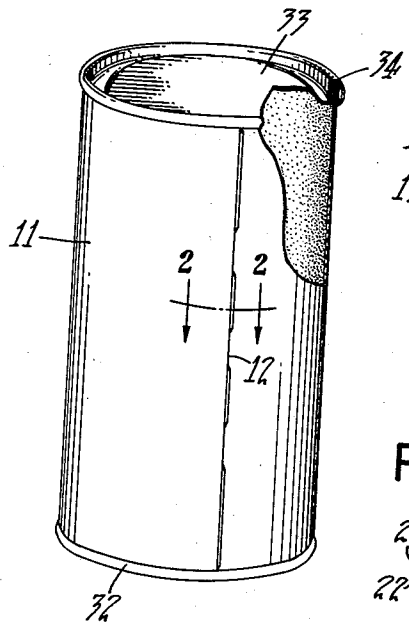


FIG. 2

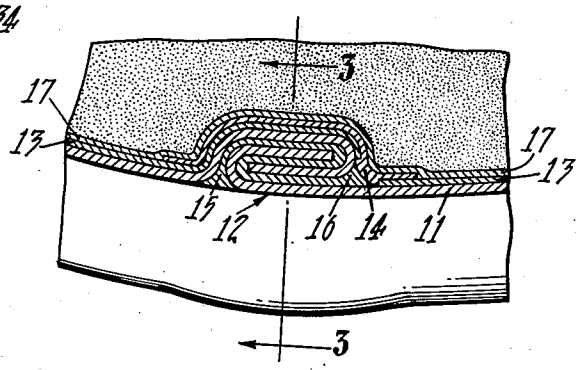


FIG. 4

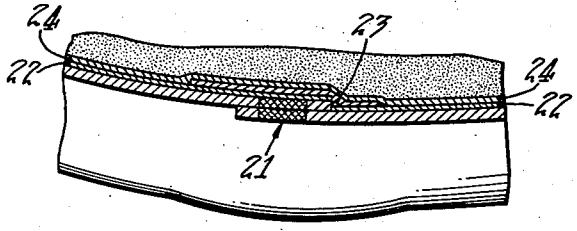
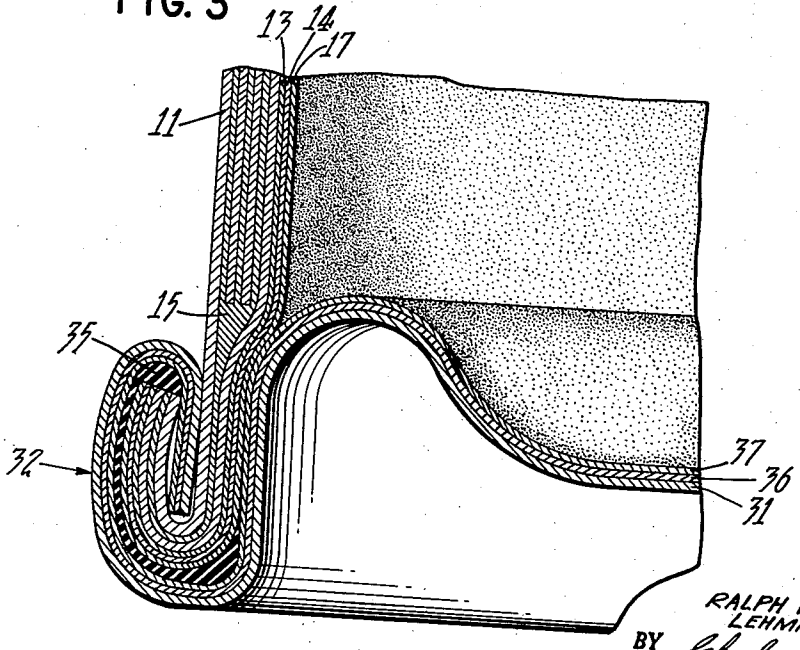


FIG. 3



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CONTAINER

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5 Claims. (Cl. 220—64)

The present invention pertains to a container having a novel coating on its inside surface. More particularly it pertains to a sheet metal container having its interior surface coated with a plurality of resinous films, one of which has an ion exchange resin incorporated therein.

A problem which has long confronted the canning industry is the migration of metal ions from the inner wall of a sheet metal container into the product packed in the can. Although these ions impart no toxicity to the product, they do tend to impart an off flavor and some discoloration thereto. Malt beverages, such as beer and ale, are especially sensitive to this flavor and color deterioration.

In recent years this problem has been aggravated by the trend away from tin coated sheet steel and the substitution of plain sheet steel, so called black iron, for the manufacture of metal container parts. Black iron surfaces are observed to be more susceptible to corrosion than the more passive tin surface of tin plate and thus have a greater tendency to contribute ferrous ions to the product. The electrochemical protection of the base steel by the tin coating on tin plate is of course completely lacking in plain steel plate. The use of suitable organic materials as an inside coating for the black iron cans has reduced visible corrosion to where it is no longer a serious problem. However, because of the very slight corrosion that still exists, it has heretofore been impossible to reduce the amount of ferrous ion migration from black iron surfaces into sensitive product contents such as beer or ale to an extent that no deterioration of the flavor or color of the product occurs.

Careful investigation of this problem and extensive experiments resulted in the discovery that there is a variation over the inside surface of the metal container walls of the tendency to release iron ions, i. e. a varying metal ion release potential. It has been found that because of the many can making operations involved in the creation of a finished container, i. e. slitting, bending, drawing, fluxing, soldering, welding, etc., the metal constituting certain areas of the inside walls of the container is subjected to severe treatment and conditions are created in the metal of these portions of the can which tend to liberate ferrous ions more readily than that from the lesser disturbed or substantially undisturbed portions of the can body. For instance the annular ridge formed on the inside of a can end during countersinking has a higher ferrous ion release potential than does the flat portion of the end. Also, it has been found that the side seam area of a black iron can body has a considerably higher ferrous ion release potential than the remainder of the body wall and is a major source of ferrous ions, due at least in part to the soldering or welding operation performed thereon.

The application of inside organic coatings, either in single or multiple layers, has failed to reduce the ferrous ion pickup by the product to a completely satisfactory degree. One explanation for this failure is that the thin resin film, even when considered perfectly continuous

in a macroscopic sense, contains sub-microscopic voids or pores. The thin resin film although applied in an apparently continuous condition has an appreciable and measurable permeability for water vapor and gases such as oxygen and carbon dioxide. This permeability of the film results in underfilm corrosion with production of ferrous ions in solution which ultimately find their way into the product.

It is therefore an object of the present invention to provide a sheet metal container having a resin film on its inside surface which resists the passage of ferrous ions from the metal wall of the container into the product.

Another object of the instant invention is the provision of an inside coating for a ferrous metal container which prevents the occurrence of off flavor or discoloration of the canned product upon extended storage.

A further object of the present invention is to provide a sheet metal container for beer and other carbonated beverages, which container has an inside coating that protects the delicate color and flavor of the product from deterioration by the metal of the can.

Still another object of the invention is the provision of a can fabricated at least in part from black iron which imparts no off flavor or discoloration to products such as beer and the like due to ferrous ion pickup by the product.

Numerous other objects and advantages of the invention will be apparent as it is better understood from the following description, which, taken in connection with the accompanying drawings, discloses a preferred embodiment thereof.

We have discovered that these objects may be accomplished by lining a sheet metal container with a plurality of resin films at least one of which contains an ion exchange resin capable of adsorbing ferrous ions. Since a significant source of the deleterious ferrous ions is the side seam area of the can it is preferred that the ion exchange resin containing film cover at least this portion of the inside of the can body. If desired, the ion exchange resin containing film can extend over the entire inside surface of the can.

The position of the ion exchange resin containing film in relation to the product is of great importance. Although the ion exchange resin is incorporated into the coating film to adsorb ferrous ions, it also has the capacity to adsorb or tie up other ions. For this reason, the ion exchange resin should not be in direct contact with the product, especially sensitive products such as beer; otherwise the ion exchange resin may remove flavor-giving or other essential ions from the product or exchange any adsorbed ferrous ion for these ions of the product thereby causing off-flavors and defeating the purpose of its use.

It is also preferred to interpose a film between the ion exchange resin containing film and the bare metal wall of the container. The interposed film acts as a screening barrier to prevent at least a portion of the ferrous ions available at the metal surface from reaching the ion exchange resin. If such a barrier is not interposed the ion exchange resin comes into contact with an excess of ferrous ions whereby its capacity to adsorb ions is soon reached and thereafter it will not function effectively to remove additional ferrous ions. This is because at equilibrium, i. e. when the full capacity of the resin is reached, the adsorption reaction allows the release of an equivalent amount of already adsorbed ions for any additional ions taken up. Although the disposition of a barrier film between the can body wall and the ion exchange resin containing film produces the best results and is the preferred construction, satisfactory results can be obtained by omitting the barrier film and increasing the thickness of the ion exchange resin

containing film and/or the concentration of ion exchange resin therein.

Any of the well known ion exchange resins, both cationic and/or anionic, may be incorporated in a resin film for the purpose of the present invention. Examples of cation exchange resins are those containing —SO_3H and —COOH functional groups. These functional groups may be linked to any suitable polymeric matrix such as phenol-aldehyde resins, polystyrene-divinylbenzene copolymers and the like.

The cation exchange resins function by actual adsorbtion of ferrous ions. The anion exchange resins may function by adsorption of complex ferrous anions or by exchanging the corrosive anions of the residues from prior chemical treatments or fluxing for hydroxyl ions which will precipitate ferrous ions. Included in the anion exchange resins are those having the functional groups of a quaternary ammonium hydroxide, an amino group, a guanidyl group, a dicyandiamidine group and the like. Among the polymeric matrices to which the functional groups may be linked are urea-formaldehyde type resins, melamine-formaldehyde type resins, the polyalkylene-polyamine-formaldehyde, styrene-divinylbenzene copolymers type resins and the like.

We have found that to obtain the desired results afforded by the present invention, the ion exchange resin should be present in the film in an amount of from 10% to 75% by weight of the total solids, and preferably from 20% to 30% by weight of solids. It has also been found that for best results the ion exchange resin should be uniformly distributed throughout the film. To accomplish this end the ion exchange particles should be as fine as possible and must not be so large that they cause the film to be rough or project above the surface of the film whereby direct contact with the product might result.

The word "film" is used herein in the accepted sense as describing a thin layer of material in the order of 0.05 to 0.5 mils thick. The ion exchange resin may be incorporated into the film in any suitable manner. For example the ion exchange resin may be ground to a fine particle size and then dispersed uniformly in a solution of the film forming resin dissolved in a volatile solvent. Deposition of this solution having the ion exchange resin dispersed therein on a surface and evaporation of the solvent produces a continuous film having the solid ion exchange resin uniformly distributed therethrough.

The accompanying drawing discloses a preferred and exemplary embodiment of the present invention in a sheet metal container.

Referring to the drawings:

Figure 1 is a perspective view of a side seamed container having a protective interior lining, part of the body wall being broken away to show the interior lining;

Fig. 2 is an enlarged fragmentary section taken substantially along the line 2—2 of Fig. 1 and illustrating a cross section of the lined can body at its bonded side seam;

Fig. 3 is a longitudinal fragmentary section taken through the side seam at the bottom of the can as indicated by lines 3—3 in Fig. 2; and

Fig. 4 is a view similar to Fig. 2 illustrating a container which has a lap welded side seam.

The metallic container illustrated in the drawing and lined or coated in accordance with our invention, includes a metal can body **11** having two of its edges joined together in a side seam **12**. This side seam may be of the usual soldered or compound bonded lock and lap type such as illustrated in Figs. 1, 2 and 3 of the drawing wherein two edges are hooked and interlocked along certain sections of the seam and are lapped in other sections, all sections being further soldered or otherwise bonded as with an organic adhesive to provide a tight, preferably hermetic joint.

According to the usual can manufacturing practice, a can body of this type is formed from a flat blank. Over most of one surface of the blank which later becomes the inner body wall surface a prime or base coating **13** is applied. This coating is usually applied to flat metal sheets by a well known roller coating process after which the coating is cured to form a hard, resistant film or lining by baking at an elevated temperature.

Base coat **13** may be of any suitable resinous material, the exact kind depending upon the contents to be packed into the can. It is necessary that the coating be of such a nature as to properly adhere to the metal surface to which it is applied and that it will form a proper foundation for subsequent superposed linings. In addition to forming a base coat for the superposed linings, prime coating **13** functions as a barrier film between the inside wall of the metal can body **11** and the ion exchange resin containing film **14**, more fully described hereinafter.

Following the prime coating procedure, it is usual to form the hooks or interengaging sections of the can body to produce the side seam **12**. The can body is thereafter brought into cylindrical or other tubular form and the inter-engaging hook and lapped parts brought into final position in the side seam for bonding as with solder or an organic adhesive to form an hermetic seal.

When the side seam is to be hermetically sealed by means of solder, the marginal edges of the can body blank must be free of the base coat **13** so that solder will wet the interfolded layers of metal in the side seam and securely bond them together. Upon application of the molten solder, a joint is formed in which the solder **15** extends into and around the can body hooks and forms a thin line or fillet of solder **16** on the inside of the can. As seen in Fig. 2, the line of solder **16** and a can body inside wall immediately on either side thereof is not covered by the base coat **13** enabling the ion exchange resin containing film **14** to contact the metal directly. However this gap in base coat **13** is maintained as small as possible and the film **14** is thickest at this point.

When the side seam of the container is bonded by an organic adhesive this situation does not prevail. The organic adhesive will adhere to base coat **13** thereby obviating the necessity of leaving a bare metal margin as with solder. Also any fillet of adhesive formed along the inside of the seam corresponding to solder line **16**, is non-metallic and therefore presents no problem.

According to the preferred embodiment of the present invention, the container is provided with an additional lining strip **14** (Figs. 2 and 3) which is situated on the inside of the can body and locally confined in the area of the side seam **12** and extending a short distance on each side of the seam **12**. Lining strip **14** is composed of any suitable resinous material, such as a stabilized vinyl chloride-vinyl acetate copolymer, throughout which is uniformly distributed an ion exchange resin active to adsorb or tie-up ferrous ions, for example the cationic active sulfonic or carboxylic types, or the anionic active nitrogen containing types mentioned hereinbefore. This ion exchange resin containing film may be applied in any suitable manner, as by spraying or brushing. In actual practice it has been found advantageous to spray a solution of the film forming resin in a volatile organic solvent having the ion exchange resin uniformly dispersed therein onto the portion of the can body to be coated, i. e. at least the side seam area of the inside of the can, and thereafter evaporate the volatile solvent by residual heat of the soldering operation or the external application of heat whereby a solid strip of ion exchange resin containing film is deposited. By this means the lining strip **14** merges with the final coat and extends laterally from the side edges of the side seam a sufficient distance on either side to provide a complete coverage of the can body wall at least at the seam.

Over both the base coat **13** and lining strip **14** is disposed the top or final coat **17** which separates or isolates the ion exchange resin containing film **14** from the packed product. This top coat may also be a resin, usually different from base cost **13**. The properties of top coat **17**

depend upon the product contents of the can and must impart no off flavor or clouding effect upon the contents. For example, a well known copolymer of vinyl chloride and vinyl acetate may be used for the top coat **17**. As is the side seam stripe **14**, the top coat **17** is usually applied by spraying the inside of the can with a solution fo the resin in a volatile solvent. A solid continuous film is then produced by the evaporation of the solvent by the application of heat. To prevent softening of the bonding agent, i. e. solder or organic adhesive, the drying of films **14** and **17** must be done at moderately elevated temperatures which are below the melting point of the bonding agent and are usually below the temperature used to cure base coat **13**.

A satisfactory container for holding beer, ale or other products which have a tendency to attack raw metal such as the iron base of the can may be made by joining the marginal edges of the can body **11** into a welded side seam **21** (Fig. 4) as an alternative form. In the welded side seam, the marginal edges of the body blank are overlapped rather than interfolded by means of hooks as in the soldered or cemented side seam. The overlapped portions are then welded or fused by means of heat to form an integral joint along the marginal edges of the body.

When such a welded side seam is used instead of a soldered seam, the interior surface of the welded body is covered with a prime or base coat **22** which may be similar to base coat **13** in its method of application and nature. This prime coat may cover the entire inner surface of the blank prior to the welding operation, although a better welding bond is produced where the lapped edges of the blank are left free of any lining. In either case the welding of the side seam produces an exposed metallic surface on the inside of the can which is not satisfactorily covered by the base coat **22**.

According to the preferred embodiment of the present invention, a protective ion exchange resin containing film **23** is applied on the inside of the can body along the welded portion and extends laterally a sufficient distance on both sides of the side seam to protect fully or cover the entire side seam area. As with the soldered side seam, the gap in base coat **22** at the welded side seam is maintained at a minimum and film **23** is thickest at the places where it contacts bare metal. The container is then subjected to a further lining step so that there is produced a continuous top or final coat **24** completely covering the inside of the can body.

With the can body properly jointed at its side seam as by soldering, welding or cementing with an organic adhesive and fully lined as described hereinbefore, a flanged can end or bottom **31** may be secured in the usual manner to the flanged can body as by a conventional double seam **32**. The can may then be filled with the contents in any suitable manner after which a top end **33** (Fig. 1) is secured to the opposite open end of the can as by the usual double seam **34**. To provide a hermetic joint in the top and bottom end seams **32** and **34**, a rubbery gasket or end lining compound **35** is disposed in the double seam in a well known manner.

The can ends **31, 33** also have a suitable protective lining on their inner surfaces, as for example, a double

coating consisting of a base or prime coat **36** and a final or top coat **37** which may be similar to the base coat and top coat on the interior of the can body. If desired the can ends **31, 33** may also have coated on the interior surface thereof an ion exchange resin containing film situated beneath the top coat **37**. Further, the can ends **31, 33** may be fabricated from the same type of metal as the can body **11** or may be of a different type of metal, e. g. a tin plate body with black iron ends.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

We claim:

1. A container comprising a tubular body member and end members, each of said end members being joined to said body member by an end seam, at least one of said members being metallic, said metallic member having a varying potential to release metal ions into a product in said container, an organic base coating substantially completely covering the inside surface of said metallic member, a solid organic film covering at least that portion of the inside of said metallic member having the greatest metal ion release potential, an ion exchange resin uniformly distributed throughout said film to adsorb any released metal ions coming into contact with said ion exchange resin, and an organic top coating covering the entire inside surface of said film whereby said film is interposed between said base coating and said top coating to separate said film from said product and substantially from the metal surface of said metallic member.

2. The container defined in claim 1 in which at least one of said end members is black iron.

3. The container defined in claim 1 in which said body member is black iron.

4. The container defined in claim 1 in which each of said members is black iron.

5. A can body for holding beer and other products comprising a tubular sheet metal body having a longitudinally extending side seam, an organic base coating covering substantially the entire inside metal surface of said can body, a solid organic film superposed on said base coat and covering said side seam, an ion exchange resin distributed uniformly throughout said film to adsorb metal ions liberated by said sheet metal can body and coming into contact with said ion exchange resin, and a continuous organic top coating covering said base coating and said film whereby said film is interposed between said base coating and said top coating to separate said film substantially from the metal wall of said can body and from said product.

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