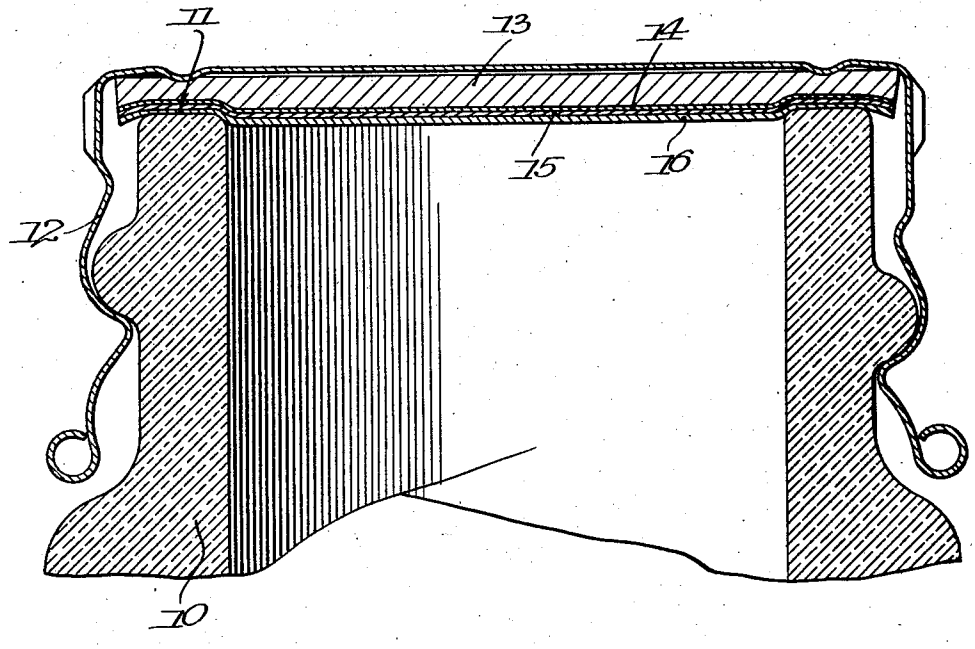
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COATED FOIL

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COATED FOIL

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This invention relates to the coating of metal and particularly light-gauge metal.

A specific purpose toward which our invention is directed is the production of a coated metallic foil, and particularly a coated aluminum foil, which is suitable for contact with all food products. Also, it is an object of our invention to produce a coated metallic foil, such as aluminum foil, which is also suitable for contact with cosmetics, medicinal products, alcoholic beverages, and the like. A further object is the provision of a liner assembly for container closures, composed of a compressible plaque of non-metallic material, a facing of metallic foil on the compressible plaque and the exposed surface of the metallic foil facing being covered by a coating which is suitable for contact with beverages, foods, cosmetics and the like.

In order to be satisfactory for these uses, the foil coating must be highly resistant to chemical action; it must not be tacky nor thermoplastic, and, conversely, must possess resiliency or elasticity, and must be firmly bonded to the metallic base; it must be odorless and tasteless; and, desirably, the foil as coated should be of pleasing appearance.

In connection with the coating for the special purposes designated, it must be borne in mind that all the noted requirements must be met, and that some of the requirements are primarily inconsistent with others. It is a problem to obtain a coating which is resistant both to acids and to alkalies; it is a problem to obtain a coating which is resilient without being either tacky or thermoplastic; as a further limitation, the coating which is resistant to acids and alkalies, and which is resilient without being either tacky or thermoplastic must, for the packaging of foods, be also odorless and tasteless. Having all the qualities enumerated, the provision of a coating giving a pleasing appearance as applied to metal is highly desirable. A further and most difficult quality desirably attained in a coating which is resistant both to acids and alkalies is insolubility in alcohols, ethers, and the lighter coal-tar distillates, such as naphtha.

It should further be noted that the necessary quality of an absolute bond between the metallic base of the composite foil, and the coating film on the foil, is inconsistent primarily with an absence of tackiness and thermoplasticity as coupled with elasticity.

The material to which we have chiefly applied the coating composition is aluminum foil, annealed to render it soft and flexible. We have, however, successfully applied it to other metals such as black iron and to light-gauge sheets of aluminum and other metals which have not been worked down, or treated, to such degree that they exhibit the absolute "deadness" commonly associated with the word "foil". The ingredients of the coating consist essentially of a mixture of a resin which is characterized by the properties of neutrality, adhesion and inertness to acids and alkalies, as for example coumarone, and an oil of the drying or semi-drying type (or synthetics thereof) which coating mixture is capable of heat treatment at a relatively high temperature. Preferably but not necessarily, another resin, or mixture of resins, of the heat-curing type, is included in the mixture.

One usable formula for our coating is as follows: linseed oil, 52.2%, China-wood oil, 11.2%, "Amberol" No. F7, 16.8%; and coumarone, 16.8%. This coating is capable of heat conversion to a marked extent.

In the typical formula given, the linseed oil is the chief carrying and film-forming oil. The China-wood oil gives a quick initial set-up to the coating, thus rendering metal coated with the composition susceptible of heat treatment, with less initial drying. In addition to this specific function, the China-wood oil performs the usual properties of a drying oil in the composition. Of the resins, coumarone is desirable because of its complete neutrality, and because of its yellowing property, which latter gives a golden color to the coating when heat treated at an adequate temperature. The "Amberol" gives gloss to the coating as a whole, and tends under heat treatment to render the insolubility and resistance of the coating wider. Both the coumarone naturally, and the "Amberol" if heat treated, are resistant to chemical action.

To this formula small quantities of other ingredients are desirably added, to somewhat modify the characteristics of the coating in certain particulars. Thus we desirably add a small quantity of a wax, such, for example, as ozocerite wax, to provide an unwettable surface; and a small quantity of a surface-drying material, positively to prevent final tackiness, such as manganese acetate, manganese oxide, cobalt acetate, cobalt resinate, or cobalt naphthanate.

Suitable thinners, such as a mixture of hi-flash naphtha and water white kerosene, or other evaporative solvent, may be added in suitable proportions, and if difficulty is encountered because of separation in the thinned coating liquid, some

pine oil or its equivalent may be added, to obviate that difficulty.

It should be understood that the linseed oil used in the coating liquid should be an oxidized linseed oil. Although various types of processed oils may be used, we prefer to use a linseed oil that has been oxidized at a temperature of between 50° C. and 130° C. "Amberol" No. F7 is a phenol type resin highly modified with rosin ester. The phenolic (phenol formaldehyde) ingredient meets the definition of a heat-curing resin, in that under heat treatment it undergoes a change resulting in insolubility in many liquids which are solvents for the resin, as unsubjected to the effect of heat, and becomes resistant to chemical concentrations capable of attacking it as untreated.

In preparing the coating, the oils and the composite resin comprising the phenolic resin are treated together, and the coumarone is then added to the batch.

In applying the coating, it is spread uniformly over the surface to be coated, is allowed to level off, and is then heat treated. The application may be made by running the foil through a bath and, desirably, the leveling of the coating composition on the metallic base comprises an evaporative heating at a mildly elevated temperature in the neighborhood of 270° F. and preferably not substantially exceeding 300° F. In some cases we prefer to run the foil through the bath twice and to level off or set the coating after each immersion and before the final heat treatment.

For this example of coating we have found a temperature of approximately 425° F. suitable for the heat treatment, because at that temperature complete heat conversion of the material may be obtained. At 425° F. the heat treatment should be continued for a period of approximately fifteen minutes. Even though an adequate treatment be obtained at the lower temperature of 425° F., it is desirable commercially to utilize a temperature sufficiently in excess of 425° F. to minimize the time period of the heat treatment. We have successfully heat treated this coating on aluminum foil at temperatures substantially above 425° F., with a substantial reduction in the time period of treatment.

If the coating should not be adequately heat treated, its maximum quality of insolubility would not be attained. It would not be wholly odorless and tasteless, and would not acquire the desirable lack of thermo-plasticity. Further, if adequate heat treatment were not given, the coating would lack resiliency and the toughness necessary to make it in effect a part of the aluminum foil.

We have, additionally to the coated foil described above, produced an improved coated foil, such as a coated aluminum base foil, which may be considered a perfect foil for the packaging of foods, cosmetics, and pharmaceuticals. This is for the reason that in it we have a coated foil which is, so far as we have been able to discover, wholly resistant to, and insoluble in beverages, food juices, alcohol, cosmetics, and pharmaceuticals of the usual grade. This universal inertness is accompanied by a perfect bond between the metallic base of the foil and the coating, by absence of tackiness and thermoplasticity, by toughness and resiliency, and by an absence of taste or odor.

While our coated foil first described is adequately resistant to acids and alkalies to be substantially unaffected by any food product brought into contact with it, and whereas it is substantially insoluble in alcohol, it is to some extent affected by the hydrocarbon distillates possessing higher degrees of solvent action, such as the coal tar solvents. While the action of coal tar distillates does not detract from the desirability of a coated foil as used, for example, in lining the caps for containers of food products, it detracts from the universality of metal or metallic foil coated by it as produced for general purposes, which may include the packaging of pharmaceuticals, cosmetics, and the like.

As distinguished from our result herein first described, the improved result is obtained primarily by substituting for the phenolic heat-curing resin represented by "Amberol" No. F7 a heat-curing resin in unmodified condition, such as those known generally as one hundred percent, heat-curing phenolic resins.

An approximate typical formula for our improved coating material may be given as follows: linseed oil 55%, China-wood oil, 11%, coumarone, 23%, a phenolic unmodified heat-curing resin, 11%.

As explained in connection with the preceding formula, the linseed oil should be an oxidized oil. We have successfully used a linseed oil which has been treated to a point at which it acquires a body as heavy as "Q-tube", by the Gardner & Holt viscosity tube test. The primary function of the linseed oil in the composition is to facilitate the curing of the phenolic resins.

The China-wood oil, as included in the composition, contributes quick initial set-up during heat treatment.

The phenolic resin is capable of forming a new condensation product, as compounded with suitable oils, when it is coated on a heat-enduring surface, and exposed to adequate temperature for an adequate period of time. We have found that we may obtain adhesion to a metallic surface generally and, specifically, to aluminum or aluminum foil when using one hundred percent, phenolic resin, unmodified by rosin or other natural gums.

The coumarone resin is a synthetic resin, which is chemically neutral, and which is acid and alkali resistant. The phenolic resins are inherently deficient in the property of adhesion, being primarily molding resins. The very fact of their marked heat-curing properties indicates a tendency to mold on a surface, rather than adhere to it. Certain one hundred percent phenolic resins, examples of which will be hereinafter given, are so prepared as to possess adhesion to many surfaces, and under certain conditions when worked up with suitable drying oils. In our composition, however, the coumarone itself so modifies the action of the phenolic resin without the assistance of acid resins, such as natural gums, as to produce perfect adhesion between the coating and a metal surface, such as the surface of aluminum, to which adhesion is difficultly obtainable. In the coating composition, the coumarone further performs the incidental but important function described in connection with our earlier coating, of providing a rich golden color under the influence of heat.

Examples of phenolic heat-curing resins which we have used are "Amberol" ST-137, "Bakelite" No. 1329, "Bakelite" No. 3360, "Beckacite" No. 1001, and "Durez" No. 500. It is our understanding that all of these phenolic heat-curing resins are one hundred percent phenolic.

Preparatory to applying the coating, it is thinned with a suitable evaporative solvent. A

mixed solvent thinner, which we may cite as typical, comprises 80% 150° water white kerosene, 10% hi-flash naphtha, and 10% pine oil, or its equivalent. Desirably, we add a small quantity of ozocerite wax, to provide an unwettable surface; and a small quantity of a metallic drier, such as cobalt linoleate or cobalt naphthanate, to expedite surface drying.

In applying the coating, it is spread uniformly over the metal foil or other surface to be coated, is allowed to level off, desirably being subjected to evaporative drying at a moderately elevated temperature in the neighborhood of 270° F. and preferably not substantially above 300° F., and then heat treated to a cure.

As in the case of our first described coating, the evaporative drying serves to set the coating in preparation for the final heat treatment. The coating may be applied by immersing the metal in a bath of the coating material and this may be done a plurality of times with intermediate and final evaporative drying.

In some instances, it is only necessary to protect one side of the foil. In such instances, we may, after immersing the foil in the coating bath, hold a bar against one side of the foil as it emerges from the bath. The bar scrapes off nearly all of the coating on the side which it contacts, leaving a very minute film of the coating. When such foil is heat treated, the protective coating described above will be formed on one side of the foil and the minute film on the other side of the foil will become somewhat irridescent in appearance. Such foil may, of course, be produced more economically than the foil which is coated on both sides because of the saving in materials, and it has the further advantage of ornamentality and individuality which characterizes a foil having a protective coating on one side and an irridescent coating on the other side. Moreover, when the usual rollers are utilized for the purpose of drawing the foil through the coating apparatus, an increase in the speed of treatment may be obtained, if the scraped side of the foil contacts the rollers, by reason of the fact that the minute film of coating material loses its tackiness very quickly.

We have found that a heat treatment at a temperature of approximately 600° F. is very satisfactory for this improved coating, a period of treatment of from one to two minutes being adequate at that temperature. At lower temperatures the time period of treatment must, of course, be extended. Very good results have been obtained at a temperature range of 640°–660° F. maintained for not more than one and one-half minutes. We have also heat treated aluminum foil with our coating material at a temperature of approximately 800° F., and at that temperature the period of treatment was less than one minute. The product was satisfactory, save that the color of the coated foil was darker than preferred for most purposes, indicating that at such high temperature the time period should be very short, if a bright, golden color is to be obtained. It may be here noted that with both of our formulae the depth of color in a bright coated metal follows within limits the time-temperature factor, deeper color being obtained relatively by extending the time or increasing the temperature.

We have noted the fact that at a temperature of 549° F. aluminum passes through a stage of re-crystallization. When, therefore, we conduct the heat treatment at or above the temperature of 549° F., it is probable that aluminum foil, upon which the coating has been applied, partakes also in the heat treatment, so that the toughness of the aluminum foil is increased, and an intermolecular bond possibly formed between the coating and the aluminum. We have observed, as a positive effect, an increase in the softness of the aluminum foil when the temperature of heat treatment is in excess of 549° F. By subjecting hard unannealed aluminum foil with the coating thereon to a temperature of heat treatment in excess of 549° F., even though the treatment was continued for no more than two minutes, the aluminum foil was sufficiently annealed and softened to render the coated product suitable for some of our contemplated uses.

When aluminum foil or other metal is coated according to our preferred procedure, the coating is so resistant to acids, alkalies, alcohols, and various solvents in the concentration in which they are encountered in general trade that it may be considered a substantially universally resistant coating for usual purposes. That is, we know of no ingredient met with in food products, cosmetics, or pharmaceuticals, which are of wide distribution, capable of acting upon the surface of metal so coated.

As examples of tests to which we have subjected our coated aluminum foil, we have maintained it in continuous contact with the condiment known as chile sauce for a period of time in excess of six months, with no appreciable detriment to the substance or appearance of the lining material. We have submerged black iron, coated with our improved coating material, in six per cent (6%) sulphuric acid, until the iron was wholly destroyed, without any observable effect on the coating; and we have submerged aluminum foil so coated in a ten per cent (10%) caustic alkali solution, until the aluminum was wholly destroyed, without any observable effect on the coating.

As above indicated, the use for which our coated metal, in the form of coated foil, is specifically designed is as a contents-contacting material for the packaging of beverages, foods, pharmaceuticals, and cosmetics, and particularly as a sealing surface on liners for container caps of various sorts. We have been unable to observe any deterioration whatever in foil coated in accordance with our preferred procedure as subjected to the action of any food product, or to the more severe action of cosmetics, distilled alcoholic liquors and pharmaceuticals.

A quality which both our formulae possess in common is the quality of forming a perfect seal with the edge of a container opening. We have applied aluminum foil, coated both in accordance with our first noted procedure and our preferred procedure, to the liners of screw and lug caps, and other caps, in the application of which no high degree of pressure may be exerted. These liners have been applied with a suitable adhesive, "Plexigum", an adhesive of recent development, being used, so that the foil covers the entire surface of the liner. The contact of the container edge is, therefore, wholly upon the foil, and no contact with material surrounding a central spot of foil is had.

This use of the coated foil is illustrated in the accompanying drawing, wherein a container 10 having a rim 11 is shown with a screw cap 12 applied thereto. A disc or plaque of compressible material 13, known as a liner, is disposed within the cap in the conventional manner and has applied thereto, by means of a suitable adhesive 14,

a facing of aluminum foil 15. The exposed surface of the facing is coated as shown at 16 in the manner above described. It will be understood that the thickness of the coating is somewhat magnified in the drawing, for the purpose of illustration.

We have conducted the following experiment, for the retention of vacuum in glass jars so sealed. This experiment comprised covering water partially filling a glass jar with a layer of gasoline or benzine, and igniting this inflammable substance to expel air, and form a partial vacuum. A lug cap lined by us was then applied, and the jar inverted. After an extended period of time no loss of vacuum was found in any one of a number of jars so sealed.

The use of our coated foil on the usual fluted bottle caps having a composition cork liner resulted in a perfect seal for retaining gases, with the foil applied to cover the entire surface of the liner. Thus charged waters were found to wholly retain their gaseous content, even though the entire contact of the bottle edge was with the coated foil.

The fact that our coated foil provides an adequate sealing medium is of great commercial importance. As is well known, the custom has recently grown up of applying centrally located spots of coated paper, or foil, to the liners of container caps of various sorts. The theory of such spot application is that an adequate seal is provided by having a portion of the container rim bear directly against the uncovered region of the liner, while the opening of the container lies wholly in line with the coated spot. Since such spots must be accurately centered, the cost of applying them is relatively great.

Since the cost of applying spots in centered position greatly outweighs any saving in material due to lesser area of the spots, the fact that our coated material is suitable for application to completely cover the cap liner results in a substantial economy.

We attribute the formation of a perfect seal, by pressing the edge of a container against liner material covered by our coated aluminum foil, to the fact that the coating is, in effect, a part of the foil, and is distorted therewith upon compression of the material covered by the foil, and also to the resiliency or elasticity of the coating, which causes it to closely engage the edge of the container. Obviously, our coated foil is suitable for use as spots on a container cap liner, if it be desired so to use it.

While we have referred particularly to coumarone resin in describing the above modifications, we have found that indene resins may be used and it will be understood that many commercial coumarone resins, which can be successfully used, consist of mixtures of coumarone and indene polymers. Moreover, other synthetic resins having the general qualities of neutrality, adhesion, and inertness to acids and alkalies, possessed by coumarone, are also to be regarded as equivalents of coumarone. As examples of equivalent resins which we have successfully substituted in like proportion for coumarone, we refer to synthetic petroleum resins, such as "Pur-o-resin", polymers of dihydro-naphthalene, such as Du Pont "RH-35", and polymers of cyclo-pentadiene and other cyclic dienes, such as "Nuba", we have also successfully used substituted and other modified coumarone-indene resins.

The "Pur-o-resin" referred to above is manufactured by the Pure Oil Company, and is designated by them as P-198. This is a solid petroleum resin having a specific gravity of 1.023–1.029, a melting range of 170°–190° F., a minimum iodine number of 200, and a molecular weight of approximately 700. It consists of reduced hydrocarbon polymers produced by the polymerization of petroleum distillates obtained by vapor phase cracking. This may be produced, for example, as disclosed in the Chittick patent No. 1,891,079 of December 13, 1932.

The Du Pont "RH-35" referred to above is manufactured by E. I. du Pont de Nemours & Co. Inc. This is a solid resin having a specific gravity of 1.14, a melting range of 212°–248° F., and it is described and claimed in Patent No. 2,108,213 of February 15, 1938.

The "Nuba" resin is manufactured by the Neville Chemical Company. It is a solid dark stable resin differing in properties from the well known coumarone-indene resins, principally in that it is harder and tougher. We understand that it consists principally of cyclo-pentadiene and other cyclic dienes in highly polymerized state. It is manufactured and sold in three grades having the following characteristics:

	Nuba #1	Nuba #2	Nuba #3
Melting point range ..... ° F.	176–203	212–257	275–302
Color	13 to 16	14 to 17	16 to 19
Insoluble in petroleum benzine ..... percent	8	33	45
Insoluble in benzol ..... percent	6	14	18
Ash ..... percent	13	18	27
Fracture form	Grainy	Grainy	Grainy
Form	Solid	Solid	Solid

We have also used "Nevillite", a resin manufactured by the Neville Chemical Company, which has the following properties:

Specific Gravity at 68° F.	1.046 (average)
Color	Water white
Form	Glassy lumps
Melting points (graded)	50° F. to 329° F.
Iodine value	Approximately 2
Chemically inert	Strong acids, alkalies and salt solutions have little or no effect and it is alcohol resistant.

As approximately equivalent oils for the processed linseed oil and China-wood oil we may mention sunflower seed oil, soya bean oil, refined and purified fish oil. Of these fish oil by recent development has been made almost identical with linseed oil. Perilla oil is a fast drying oil, but if used to replace China-wood oil we should suggest that it be included in a somewhat larger proportion, if quick initial set-up is to be obtained.

It may be noted that certain of the resins used have of themselves an unpleasant odor and taste. The heat treatment to which the coating is subjected performs the additional function of eliminating the taste and odor.

In the formulae given, the relative proportions are by weight and not by volume.

It has been explained that the color of the coating depends on the time-temperature factor in heat treatment. If, therefore, it is desired to obtain an unusually light color, this effect is obtained at some sacrifice in completeness of cure. By using a heat-curing resin of the phthalic anhydride glycerine type (glyptal) instead of phenol type heat-curing resin, a very light color may be obtained at a high curing temperature, such as 600° F. This is because the glyptal resin modifies the yellowing property of the coumarone.

We have made and applied such a coating as follows:

Taking three parts by weight of glyptal No.

1231, which is an oil modified phthalic anhydride glycerine resin, and one part by weight of coumarone, we prepare a coating by dissolving these resins in a solvent naphtha pine oil solvent, using six pounds of resin to a gallon of solvent.

This coating we applied to the foil and heat treated the coated foil at a temperature of about 600° F. for a period of about ten minutes.

Because a rich golden color is in general a desirable quality of foil coated for our specific purpose, we have not experimented widely with foil coated with a glyptal resin. It is, however, odorless and tasteless, and appears to have good qualities of resistance and insolubility. It may be noted that in this coating composition the coumarone negatives the undesirable water solubility of the glyptal resin.

Although the phenolic and glyptal heat-curing resins referred to in the above examples contribute, when heat treated, increased resistance to solvents and also, in some instances, enhance the appearance of the final coating, we have obtained coatings having sufficient resistance for most purposes without the use of the heat-curing resin. Therefore the invention, in its broad aspect, is not to be regarded as limited to the use of heat-curing resins.

For example, we have used as a coating on both black iron and aluminum a mixture of approximately 120 grams of linseed oil and approximately 100 grams of coumarone, thinned with an approximately equal part of an evaporative solvent consisting of 90% of kerosene or varnish makers and painters naphtha and 10% xylol. This composition was applied to the metal in the manner described above and was heat treated for approximately two minutes at a temperature which ranged between 610° F. and 620° F. This coating is resistant to alcohol and to weak acids and alkalies such as may be found in ordinary beverages and food products.

The above disclosure constitutes in part a continuation of our application Serial No. 245,314, filed December 12, 1938, which was in part a continuation of our application Serial No. 33,240, filed July 26, 1935, which application was in part a continuation of our application Serial No. 705,379, filed January 4, 1935 and the above disclosure also constitutes in part a continuation of our application Serial No. 245,315, filed December 12, 1938, which was also in part a continuation of our application Serial No. 705,379, filed January 4, 1935.

We claim:

1. The herein described method of bonding to the surface of a body of metal, such as aluminum or iron, a coating having perfect adhesion with the metal and of qualities rendering it wholly suitable for use in contact with food products, cosmetics, pharmaceuticals, and the like, which comprises incorporating in a coating solution containing film-forming oil and at least one evaporative solvent both a heat-curing resin and a synthetic resin having the general qualities of neutrality, adhesion, and inertness to acids and alkalies possessed by coumarone resin, said synthetic resin being selected from a group consisting of coumarone, polymers of dihydronaphthalene, and reduced hydrocarbon polymers produced by the polymerization of petroleum distillates obtained by vapor phase cracking, spreading the coating composition evenly over the surface of the metallic base, and effecting conversion of the coating with perfect adhesion to the metallic base and chemical inertness in the coating by heating the assembly of metallic base and applied coating to a temperature not less than approximately 600° F., and continuing the heat treatment at a temperature not less than approximately 600° F. for a period of time less than 2 minutes adequate at a temperature of such elevation effectively to convert the coated face of the material into a condition in which it is elastic and free from thermoplasticity.

2. A coated body of metal, such as aluminum or iron, having bonded thereto a coating comprising both a heat-curing resin and a synthetic resin having the general qualities of neutrality, adhesion, and inertness to acids and alkalies possessed by coumarone resin, said synthetic resin being selected from a group consisting of coumarone, polymers of dihydronaphthalene, and reduced hydrocarbon polymers produced by the polymerization of petroleum distillates obtained by vapor phase cracking, said coating and metallic base having perfect mutual adhesion and the coating of the composite body being elastic, free from thermoplasticity, tasteless and odorless, and wholly inert to chemical concentrations existing in foods, beverages, pharmaceuticals, and the like; said coated body of metal being the product obtained from the procedure defined in claim 1.

3. The herein described method of bonding to the surface of a body of metal, such as aluminum or iron, a coating having perfect adhesion with the metal and of qualities rendering it wholly suitable for use in contact with food products, cosmetics, pharmaceuticals, and the like, which comprises incorporating in a coating solution containing also a film-forming oil and at least one evaporative solvent a synthetic resin having the general qualities of neutrality, adhesion, and inertness to acids and alkalies possessed by coumarone resin, said synthetic resin being selected from a group consisting of coumarone, polymers of dihydronaphthalene, and reduced hydrocarbon ploymers produced by the polymerization of petroleum distillates obtained by vapor phase cracking, spreading the coating composition evenly over the surface of the metallic base, and effecting conversion of the coating with perfect adhesion to the metallic base and chemical inertness in the coating by heating the assembly of metallic base and applied coating to a temperature not less than approximately 600° F., and continuing the heat treatment at a temperature not less than approximately 600° F. for a period of time less than 2 minutes adequate at a temperature of such elevation effectively to convert the coated face of the material into a condition in which it is elastic and free from thermoplasticity.

4. A coated body of metal, such as aluminum or iron, having bonded to the surface thereof a coating comprising a synthetic resin having the general qualities of neutrality, adhesion, and inertness to acids and alkalies possessed by coumarone resin, said synthetic resin being selected from a group consisting of coumarone, polymers of dihydronaphthalene, and reduced hydrocarbon polymers produced by the polymerization of petroleum distillates obtained by vapor phase cracking, said coating and metallic base having perfect mutual adhesion and the coating of the composite body being elastic, free from thermoplasticity, tasteless and odorless, and wholly inert to chemical concentrations existing in foods, beverages, pharmaceuticals, and the like; said coated body being the product obtained from the procedure defined in claim 3.

5. The herein described method of bonding to the surface of an aluminum base a coating integrated to the aluminum and of qualities rendering it wholly suitable for use in contact with food products, cosmetics, pharmaceuticals, and the like, which comprises incorporating in a coating solution containing a film-forming oil and at least one evaporative solvent both a heat-curing resin and a synthetic resin having the general qualities of neutrality, adhesion, and inertness to acids and alkalies possessed by coumarone resin; said synthetic resin being selected from a group consisting of coumarone, polymers of dihydronaphthalene, and reduced hydrocarbon polymers produced by the polymerization of petroleum distillates obtained by vapor phase cracking, spreading the coating composition evenly over the surface of the aluminum base, and creating a bond between the aluminum base and a coating thereon in effect integrating them into a composite inseparable whole by heating the assembly of aluminum base and applied coating to a temperature no lower than 549° F. the critical temperature of the aluminum, and continuing the heat treatment at a temperature not below 549° F. for the relatively short period of time adequate at a temperature of such elevation effectively to convert the coated face of the material into a condition in which it is elastic and free from thermoplasticity.

6. A coated body of aluminum having bonded thereto a coating comprising both a heat-curing resin and a synthetic resin having the general qualities of neutrality, adhesion, and inertness to acids and alkalies possessed by coumarone resin, said synthetic resin being selected from a group consisting of coumarone, polymers of dihydronaphthalene, and reduced hydrocarbon polymers produced by the polymerization of petroleum distillates obtained by vapor phase cracking, said coating and aluminum base being integrated into a composite inseparable body and the coating of the composite body being elastic, free from thermoplasticity, tasteless and odorless, and wholly inert to chemical concentrations existing in foods, beverages, pharmaceuticals, and the like; said coated aluminum body being the product obtained from the procedure defined in claim 5.

7. The herein described method in accordance with the procedure of claim 1 in which the heat curing resin of the coating composition is a modified phenolic heat curing resin.

8. The herein described method in accordance with the procedure of claim 1 in which the heat curing resin of the coating composition is a one hundred percent phenolic heat curing resin.

9. The herein described method in accordance with the procedure of claim 1 in which the heat curing resin of the coating composition is a glyptal heat-curing resin.

10. The herein described method in accordance with the procedure of claim 5 in which the heat curing resin of the coating composition is a modified phenolic heat curing resin.

11. The herein described method in accordance with the procedure of claim 5 in which the heat curing resin of the coating composition is a one hundred percent phenolic heat curing resin.

12. The herein described method of bonding to the surface of light-gauge metal, such as aluminum or iron, a coating of qualities rendering it wholly suitable for use in contact with food products, cosmetics, pharmaceuticals, and the like, which comprises incorporating in a coating solution containing drying oil and at least one evaporative solvent both coumarone resin and a heat-curing resin in substantial proportion with respect to each other, spreading the coating composition evenly over the surface of the metallic base and effecting conversion of the coating with perfect adhesion to the metallic base and chemical inertness in the coating by heating the assembly of metallic base and applied coating to a temperature not less than approximately 600° F. and continuing the heat treatment at such elevated temperature for a period of time less than two minutes adequate at a temperature of such elevation effectively to convert the coated face of the material into a condition in which it is elastic and free from thermoplasticity.

13. The herein described method of bonding to the surface of light-gauge aluminum a coating integrated with the aluminum and of qualities rendering it wholly suitable for use in packaging food products, cosmetics, pharmaceuticals, and the like, which comprises incorporating in a coating solution containing film-forming oil and at least one evaporative solvent both coumarone resin and a heat-curing resin in substantial proportion with respect to each other; spreading the coating composition evenly over the surface of the aluminum base, and creating a bond between the aluminum base and the coating thereon in effect integrating them into a composite inseparable whole by heating the assembly of aluminum base and applied coating to a temperature no lower than 549° F. the critical temperature of the aluminum and continuing the heat treatment at that temperature for the relatively short period of time adequate at a temperature of such elevation effectively to convert the coated face of the material into a condition in which it is elastic and free from thermoplasticity.

14. The herein described method in accordance with the procedure of claim 13 in which the heat curing resin of the coating composition is a modified phenolic heat curing resin.

15. The herein described method in accordance with the procedure of claim 13 in which the heat-curing resin of the coating composition is a one hundred percent phenolic heat-curing resin.

16. A coated light-gauge body of aluminum having bonded to at least one face thereof a coating comprising both coumarone resin and a heat-curing resin, said coating and aluminum base being integrated into a composite inseparable body and the coating of the composite material being elastic, free from thermoplasticity, tasteless and odorless, of substantially universal insolubility, and wholly inert to chemical concentrations existing in foods, beverages, pharmaceuticals, and the like; said coated aluminum body being the product obtained from the procedure defined in calim 13.

17. The herein described method of bonding to the surface of light-gauge aluminum a coating integrated with the aluminum and of qualities rendering it wholly suitable for use in packaging food products, cosmetics, pharmaceuticals, and the like, which comprises incorporating coumarone resin in a coating solution containing also a film-forming oil and at least one evaporative solvent; spreading the coating composition evenly over the surface of the aluminum base, and creating a bond between the aluminum base and the coating thereon in effect integrating them in a composite inseparable whole by heating the assembly of aluminum base and applied coating to a temperature no lower than 549° F. the critical

temperature of the aluminum, and continuing the heat treatment at that temperature for the relatively short period of time adequate at a temperature of such elevation effectively to convert the coated face of the material into a condition in which it is elastic and free from thermoplasticity.

18. A coated light gauge body of aluminum having bonded thereto a coating comprising coumarone resin, said coating and aluminum base having perfect mutual adhesion and the coating of the composite body being elastic, free from thermoplasticity, tasteless and odorless, and wholly inert to chemical concentrations existing in foods, beverages, pharmaceuticals, and the like; said coated body of aluminum being the product obtained from the procedure defined in claim 17.

19. The herein described method of bonding to the surface of an aluminum base a coating integrated with the aluminum and of qualities rendering it wholly suitable for use in contact with food products, cosmetics, pharmaceuticals, and the like, which comprises incorporating in a coating solution containing also a film-forming oil and at least one evaporative solvent both a heat curing resin and a synthetic resin having the general qualities of neutrality, adhesion, and inertness to acids and alkalies possessed by coumarone resin, said synthetic resin being selected from a group consisting of coumarone, polymers of dihydronaphthalene, and reduced hydrocarbon polymers produced by the polymerization of petroleum distillates obtained by vapor phase cracking, spreading the coating composition evenly over the surface of the aluminum base, and creating a bond between the aluminum base and the coating thereon in effect integrating them into a composite inseparable whole and simultaneously annealing the aluminum base by heating the assembly of aluminum base and applied coating to a temperature no lower than 549° F. the critical temperature of the aluminum, and continuing the heat treatment at a temperature not below 549° F. for the relatively short period of time adequate at a temperature of such elevation effectively to convert the coated face of the material into a condition in which it is elastic and free from thermoplasticity.

20. The herein described method of bonding to one surface of an aluminum foil a coating integrated with the aluminum and of qualities rendering it wholly suitable for use in contact with food products, cosmetics, pharmaceuticals, and the like, which comprises incorporating in a coating solution containing also a film-forming oil and at least one evaporative solvent both a heat curing resin and a synthetic resin having the general qualities of neutrality, adhesion, and inertness to acids and alkalies possessed by coumarone resin, said synthetic resin being selected from a group consisting of coumarone, polymers of dihydronaphthalene, and reduced hydrocarbon polymers produced by the polymerization of petroleum distillates obtained by vapor phase cracking, spreading the coating composition evenly over both surfaces of the aluminum foil by immersing the foil in a bath of the coating composition, scraping off nearly all of the coating composition from one side of the foil as it emerges from the bath, and creating a bond between the aluminum foil and the coating thereon in effect integrating them into a composite inseparable whole by heating the assembly of aluminum foil and applied coating to a temperature no lower than 549° F. the critical temperature of the aluminum, and continuing the heat treatment at a temperature not below 549° F. for the relatively short period of time adequate at a temperature of such elevation effectively to convert the coated face of the material into a condition in which it is elastic and free from thermoplasticity, and to render the composition, which remains on the scraped side of the foil, irridescent in appearance.

21. A liner assembly for container caps composed of a compressible material, a facing of metallic foil on the compressible material and a heat-converted oleo-resinous coating covering the exposed surface of the metallic foil facing and firmly bonded thereto by heat conversion at a temperature substantially in excess of 425° F. for an adequate period of time sustainable by the metallic foil, the said heat converted coating comprising a heat curing resin and a synthetic resin having substantially the qualities of neutrality, adhesion, and inertness to acids and alkalies possessed by coumarone resin, the synthetic resin being present in sufficient quantity to provide a firm bond with the metallic foil base under heat conversion of the coating thereon.

22. A liner assembly for container caps composed of a compressible plaque of non-metallic material, a facing of metallic foil at one face of the compressible plaque and a heat-converted resin-oil coating covering the exposed surface of the metallic foil facing and firmly bonded thereto by heat conversion at a temperature substantially in excess of 425° F. sustainable by the metallic foil facing; the said heat converted coating comprising film-forming oil, a heat-curing resin and coumarone resin present as a substantial proportion of the total coating, and having the coumarone present in quantity sufficient to provide a firm bond with the metallic foil base under heat conversion of the coating thereon.

23. A liner assembly in accordance with the definition of claim 21 in which the heat converted coating on the metallic foil facing of the liner assembly comprises at least one film-forming oil and a resinous content of at least a neutral synthetic resin of the hydrocarbon type.

24. A liner assembly for container caps composed of a compressible plaque of non-metallic material, a facing of metallic foil covering substantially the entire surface at one face of the compressible plaque and a heat converted resin-oil coating covering the exposed face of the metallic foil and firmly bonded thereto by heat conversion at a temperature from approximately 600° F. upward sustainable by the metallic foil, the said heat converted coating comprising film-forming oil, a heat-curing resin and coumarone as a substantial proportion of the total coating, and having the coumarone present in quantity sufficient to provide a firm bond with the metallic foil base in heat conversion of the coating thereon, the coating having elasticity adequate to form a hermetic seal with the rim of a container neck against which the coated face of the liner assembly is pressed.

25. A liner assembly for container caps composed of a compressible plaque of non-metallic material, a facing of aluminum foil at one face of the compressible plaque and a heat-converted resin-oil coating covering the exposed face of the aluminum foil and firmly bonded thereto by heat conversion at a temperature no lower than 549° F. the critical temperature of the aluminum foil, the said heat converted coating comprising film-forming oil, a one-hundred percent phenolic heat curing resin and coumarone resin present as a

substantial proportion of the total coating, and having the coumarone present in quantity sufficient to provide a firm bond with the aluminum foil base under heat conversion of the coating thereon.

26. A liner assembly for container caps composed of a compressible plaque of non-metallic material, a facing of aluminum foil covering substantially the entire surface at one face of the compressible plaque, and a heat-converted resin-oil coating covering the exposed face of the aluminum foil and firmly bonded thereto by heat conversion at a temperature no lower than 549° F. the critical temperature of the aluminum foil, the said heat-converted coating comprising film forming oil, a one-hundred percent phenolic heat-curing resin and coumarone resin present as a substantial proportion of the total coating, and having the coumarone present in quantity sufficient to provide a firm bond with the aluminum foil base under heat-conversion of the coating thereon, the coating having elasticity adequate to form a hermetic seal with the rim of a container neck against which the coated face of the liner assembly is pressed.

27. A liner assembly for container caps comprising a disc of compressible material and a facing of aluminum foil overlying said compressible material, the exposed surface of the facing having a heat-converted oleo-resinous coating thereon and firmly bonded thereto by heat conversion at a temperature in excess of 600° F. sustainable by the metallic foil, the said heat converted coating comprising a heat curing resin and a synthetic resin having substantially the properties of neutrality, adhesion and inertness to acids and alkalies possessed by coumarone resin, and having the synthetic resin present in sufficient quantity to provide a firm bond with the metallic foil base in heat conversion of the coating thereon, the coating having elasticity adequate to form a hermetic seal with the rim of a container neck against which the coated face of the liner assembly is pressed.

28. A liner assembly in accordance with the definition of claim 27 in which the heat converted coating on the metallic foil facing of the liner assembly comprises at least one film-forming oil and a resinous content of at least a neutral synthetic resin of the hydrocarbon type.

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