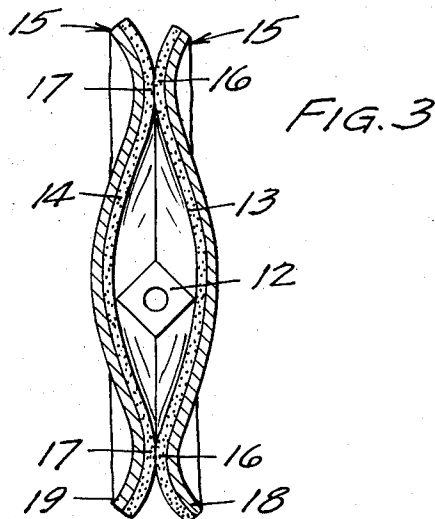
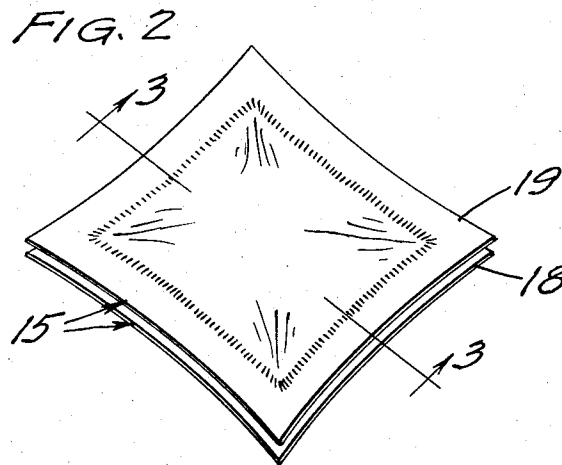
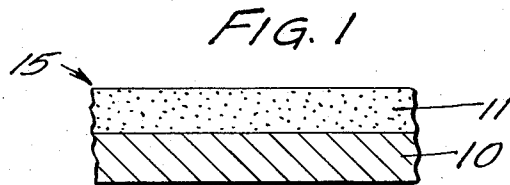


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PACKAGING MATERIAL
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2,895,270

PACKAGING MATERIAL

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7 Claims. (Cl. 53—21)

This invention relates to novel, heat-sealable, packaging material and to an improved method for packaging metal particles. More particularly, this invention relates to novel, heat-sealable, packaging or wrapping sheet material which provides a protective, corrosion-inhibiting atmosphere for packaged, grease-free, metal parts.

The automatic packaging of small metal parts, such as for example hardware items or small metal machine parts used in the automotive industry, is most expeditiously accomplished by using heat-sealable sheet materials. In packaging such small metal parts, however, care must be taken to protect the same from the corrosive action of water vapor and oxygen. Suitably the parts may be thoroughly coated with a layer of grease to prevent corrosion, but this presents difficulties in automatic packaging. The automatic packaging of greased metal parts cannot be accomplished continuously for periods of time greater than about two hours inasmuch as the packaging machinery becomes clogged with grease during operation. Grease, of course, prevents effective heat seals from being formed, and the production line for automatic packaging must frequently be shut down to permit cleaning of grease deposits from the machinery.

This invention provides a sheet material which obviates such difficulties in automatic packaging as the foregoing, and further provides a means for forming neat, compact, sealed enclosures or packages with protective, corrosion-inhibiting atmospheres. Also provided by this invention is a composite packaging or wrapping sheet material which is at once both heat-sealable and capable of imparting protective atmospheres about metal parts. The sheet material hereof is non-blocking and may be stored in rolls or stacked in sheets until used. Preferably the sheet material hereof is stored wrapped in an impervious outer wrapper of metal foil or the like. When required for use, my sheet material is readily unwound from a rolled cylinder or readily separated from other sheets of a stack.

In the drawings, Figure 1 is a cross sectional view through a layer of the packaging sheet material of this invention, illustrating the various layers thereof. Figure 2 is a perspective view of a small heat-sealed package formed using the sheet material hereof. Figure 3 is a cross sectional view through line 3—3 in Figure 2, illustrating a packaged metal article with a protective atmosphere within the enclosure.

In brief, the sheet material of this invention comprises a flexible, relatively-stiff, support member 10 and a film-like coating 11 adhered thereto. The film-like coating may be characterized as macroscopically homogeneous in that it is not evident to the naked eye that it contains a mixture of materials. Macroscopically, it has a uniform appearance, but it contains a mixture including a normally non-tacky, thermoplastic adhesive which is activatable by heat to adhesiveness, and a volatile, corrosion inhibitor uniformly dispersed throughout the adhesive.

Small metal parts are wrapped with the sheet material hereof in such a manner as to dispose the coated side of the material on the inner face, or inside, of the wrapping

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or package. This may be understood more readily by referring to Figure 3, where a metal article 12 is shown to be enclosed with the coated sides 13 and 14 of the sheet material 15 disposed inwardly. When the coated side of the sheet material is heat activated along seams and overlaps of the wrapping so as to seal the same, there is a simultaneous acceleration of the volatilization of the corrosion inhibitor from areas of the coating immediately adjacent to those areas treated with heat. The corrosion inhibitor disperses itself about the articles or contents of the package and protects the same from the corrosive effects of water vapor and oxygen within a short time after the package is heat sealed. The protective atmosphere is sealed from the external air and thereby protects the packaged metal article during shipment.

Suitably during the packaging process, the meeting edges, 16 and 17, of the sheet material are sealed by applying heat and pressure thereto using a heated mandrel, metal band, bar, etc., or combinations thereof, on one or both sides of all meeting edges. A temperature generally above about 200° F. and as high as 500° F. is suitable for activation of the adhesive. The seal or bond is made, usually simultaneously with heat activation, by applying pressure over the heat activated area for a short period of time, a period of time as short as a fraction of a second being suitable.

With the foregoing in mind, the following examples are offered as illustrative but non-limitative of the invention hereof.

Example 1

Parts by weight
(Dry basis)

Dicyclohexylammonium nitrite 3
Acrylic resin emulsion 4

Dicyclohexylammonium nitrite may be prepared according to the disclosure of U.S. Patent No. 2,449,962 (September 21, 1948). This compound has a vapor pressure at 24° C. of about 0.00016 mm. Hg. It falls in the class of compounds known as salts of nitrous acid, which are well known as volatile inhibitors of the corrosion of ferrous and related metals. Many nitrite salts, including those of various amines, nitrogenous compounds and other organic compounds than the specific one here mentioned, are well known as volatile, vapor-phase, corrosion inhibitors.

The acrylic resin was used in emulsion form at a concentration of 40% solids. Such an emulsion, as a non-ionic acrylic resin emulsion, contains as its resin component a normally non-tacky thermoplastic copolymer of vinyl acetate and acrylic monomers. The emulsion is marketed under the trade designation "WN-80" by the Rohm & Haas Chemical Company.

Both materials above were thoroughly mixed together by stirring and then knife coated (other coating techniques are also suitable) on a 40 lb. neutral kraft paper (a paper treated so that its pH remains neutral over long periods) at a dry coating weight of approximately 20 lbs. of solids per ream of paper. A ream is an area equivalent to 500 sheets of paper each measuring 24" x 36". The mixture was coated at room temperature and dried at a raised temperature of about 150° F. in a current of dry air. The sheet material was then rolled into a compact cylinder and used in the packaging of small metal machine parts.

A package such as in Figure 2 was formed and the meeting edges, illustrated as 16 and 17 in Figure 3, of the sheet material were bonded together at 350° F. and 40 p.s.i. for 1/2 second. After the so-formed package had cooled to room temperature, an attempt was made to separate the heat seal by slowly pulling on the outside loose edges, illustrated as 18 and 19 in Figure 3, of the

sheet material. This technique resulted in fibers being torn from the kraft paper backing, but the heat seal between the adjacent layers of adhesive remained intact. Tests also indicated that the heat-seal bond so formed did not permit the passage of any significant amount of the vaporized corrosion inhibitor.

The sheet material of this example will effectively inhibit harmful corrosion of small metal parts packaged therein for lengthy periods. Actual tests lasting as long as one month have furnished no evidence of harmful corrosion. Metal articles in direct contact with the coated film of the sheet material hereof gave no evidence of any contact corrosion in tests lasting also as long as one month. Metal machine parts packaged in this material may be shipped and stored for substantial and lengthy periods of time without harmful corrosion resulting.

Use of this sheet material in automatic packaging machinery permits continuous uninterrupted operation of such machinery for lengthy periods. Shut down of such machinery for cleaning purposes is reduced to a minimum or entirely obviated.

Example 2

	Parts by weight (Dry basis)
"Callex CA"	1
Acrylic resin emulsion of Example 1	1
Carboxymethyl cellulose	0.01

"Callex CA," marketed by the Daubert Chemical Company (formerly Nox Rust Chemical Corporation) of Chicago, is a trade name for a solid material which is a volatile corrosion inhibitor. It is believed to be a mixture of materials as disclosed in U.S. Patent No. 2,521,311 (September 5, 1950), and to consist of about 50% sodium nitrite, about 50% urea, and possibly a small amount of additional components such as monoethanolamine benzoate. In the making of the sheet article of this example, "Callex CA" was dissolved in water to form a solution consisting of approximately 50% solids.

The carboxymethyl cellulose was of a high viscosity type and was dissolved in water to form a 1% solid solution. It is used as a thickening agent to maintain a suitable viscosity in the mixture for coating purposes and, when used, should be employed only in small amounts. A suitable coating viscosity may vary from about 300 to 2000 centipoises at 25° C.

The three above components dispersed and dissolved in water as stated were mixed together by stirring and knife coated upon 40 lb. neutral kraft paper at a dry coating weight and under conditions of temperature as described in Example 1. Drying was also conducted as rapidly as possible using the procedure of Example 1, giving a sheet material comparable to the one of that example.

The sheet material of this example formed, upon heat-sealing, fiber tearing bonds comparable in performance to those formed using the sheet article of Example 1. Metal articles packaged with this sheet article were also free of corrosion after lengthy storage.

Other suitable volatile inhibitors of the corrosion of metals, including ferrous metals, than those employed in the examples may be used in making the sheet articles hereof, provided that the volatile corrosion inhibitor does not react with the organic resin adhesive employed to prevent film formation or otherwise adversely affect the resin. For best results, the inhibitor should have a vapor pressure at 21° C. of at least 0.00002 mm. Hg. Such volatile corrosion inhibitors may be nitrite salts of primary amines, secondary amines, tertiary amines, etc., various aliphatic and cyclic compounds, inorganic nitrites, organic acid salts, etc., and various combinations thereof. Characteristically these volatile corrosion inhibitors are chemically stable under atmospheric temperatures and possess the property of volatilizing and of being able to

inhibit corrosion of metal parts such as would otherwise be caused by the action of water vapor and oxygen.

Suitable heat-activatable adhesives for use in the sheet materials of this invention are various thermoplastic, normally non-tacky, adhesive polymers and copolymers, such as for example alkali soluble polyvinyl compounds, esters of polyacrylic acids, methacrylate resins, etc. These vinyl-type polymers may be plasticized with various additive plasticizers, or they may be internally plasticized within the polymer chain, to improve their flexibility in film form and to increase their tackiness when activated by heat. The resin adhesive may be characterized as normally non-tacky inasmuch as it does not exhibit tack at normal room temperatures, nor under conditions of normal storage and shipment, but develops tack only at elevated temperatures preferably above approximately 200° F.

Various flexible, relatively-stiff, smooth surfaced backings, such as those of various papers, paper combined with films, glassine, etc., may be used in making the sheet articles hereof. It should be noted that this invention provides a very economical barrier-type packaging material possessing the property of heat sealability as well as the property of inhibiting corrosion. If desired, films of microcrystalline wax or foils of metal may be included in the sheet support structure to serve as an added barrier film.

Coating weights of the homogeneous mixture of adhesive and volatile corrosion inhibitor may vary from about 10 to 40 lbs. of solids material (dry solids weight of the adhesive and volatile corrosion inhibitor) per paper ream of 500 sheets each measuring 24" x 36". Within this range the most suitable and useful sheet materials are produced. Dry coating weights of adhesive and corrosion inhibitor below approximately 10 lbs. per ream (as aforesaid) are generally insufficient to provide adequate heat seal characteristics as well as adequate concentration of volatile corrosion inhibitor after sealing.

The ratio of the weight of solvent-free adhesive material to solvent-free corrosion inhibitor in my films may vary widely but is generally between about 1:1.5 to 8.5:1.5. A ratio of adhesive to corrosion inhibitor below 1:1.5 generally provides insufficient adhesive for the formation of fiber-tearing, heat-sealed bonds. On the other hand, a greater ratio of adhesive to volatile corrosion inhibitor than 8.5:1.5 results usually in insufficient volatile corrosion inhibitor being present in the coating to provide adequate protection against corrosion.

Drying of the coated mixture to free it of solvents must be accomplished in such a manner that vaporization of the corrosion inhibitor is avoided or minimized and for this reason, should be accomplished at as low a drying temperature and in as short a time as possible. For practical purposes, a drying range of between approximately 140 to 180° F. is preferred and surprisingly can be used without a significant loss of the volatile corrosion inhibitor from the coating during the drying step. The maximum drying temperature employable is about 200° F., and it is preferable, as illustrated in the examples, to dry the coating at a temperature below the point at which the heat-activatable adhesive fuses and becomes tacky. Desirably, drying is accomplished as expeditiously as possible by maintaining a current of dry air over the coated layer during the drying process. The dried sheet product is then stored in wrapped rolls or stacks, as hereinbefore noted, until required for use.

I claim:

1. A packaging sheet material adapted for use in providing sealed enclosures with protective atmospheres for small, grease-free, metal articles so as to protect said metal articles from the corrosive action of water vapor and oxygen, said sheet material comprising a flexible, relatively-stiff, smooth surfaced, sheet support member and a macroscopically homogeneous film-like coating ad-

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hered thereover, said coating comprising a heat-activatable, thermoplastic, flexible, normally non-tacky, vinyl resin adhesive and a volatile inhibitor of the corrosion of metals dispersed throughout said adhesive, the weight ratio of said adhesive to said corrosion inhibitor being between 1:1.5 and 8.5:1.5 with the total dry solids coating weight of said adhesive and corrosion inhibitor being between 10 and 40 lbs. per ream of sheet support member equivalent to 500 sheets measuring 24" x 36", said corrosion inhibitor being characterized by having a vapor pressure at least greater than 0.00002 mm. Hg at 21° C. and by being non-reactive with said adhesive.

2. The sheet material of claim 1 in which the support member comprises paper.

3. A packaging sheet material adapted for use in providing sealed enclosures with protective atmospheres for small, grease-free, metal articles so as to protect said metal articles from the corrosive action of water vapor and oxygen, said sheet material comprising a flexible, relatively-stiff, smooth-surfaced, sheet support member and a macroscopically homogeneous film-like coating adhered thereover, said coating comprising a heat-activatable, thermoplastic, flexible, normally non-tacky, vinyl resin adhesive and a volatile inhibitor of the corrosion of metals dispersed throughout said adhesive, the weight ratio of said adhesive to said corrosion inhibitor being between 1:1.5 and 8.5:1.5 with the total dry solids coating weight of said adhesive and corrosion inhibitor being between 10 and 40 lbs. per ream of sheet support member equivalent to 500 sheets measuring 24" x 36", said corrosion inhibitor being characterized by having a vapor pressure at least greater than 0.00002 mm. Hg at 21° C. and by comprising a nitrogen-containing compound which is non-reactive with said adhesive.

4. The sheet material of claim 3 in which the volatile corrosion inhibitor comprises a salt of nitrous acid.

5. The sheet material of claim 3 in which the support member comprises paper.

6. A process for packaging small, grease-free, metal articles in heat-sealed, barrier-type enclosures so as to protect said metal articles against the corrosive action of water vapor and oxygen, said process comprising (1) wrapping said articles with a packaging material comprising a flexible, relatively-stiff, smooth-surfaced, sheet support member and a macroscopically homogeneous coating adhered thereover, said coating comprising a heat-

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activatable, thermoplastic, normally non-tacky adhesive and a volatile inhibitor of the corrosion of metals dispersed throughout said adhesive, said corrosion inhibitor being characterized by a vapor pressure at least greater than 0.00002 mm. Hg at 21° C. and by being non-reactive with said adhesive, said packaging material being disposed about said metal articles with its coated side facing inwardly and with areas thereof meeting to form an enclosure about said metal articles, and (2) applying heat and pressure to meeting areas of said packaging material so as to activate the adhesive in the coating thereof and form a seal between said meeting areas while simultaneously accelerating the volatilization of the corrosion inhibitor from areas of the coating immediately adjacent to those areas treated with heat, thereby to form a heat sealed enclosure with a protective atmosphere therein.

7. A packaging sheet material adapted for use in providing sealed enclosures with protective atmospheres for small, grease-free, metal articles so as to protect said metal articles from the corrosive action of water vapor and oxygen, said sheet material comprising a flexible, relatively stiff, smooth-surfaced sheet support member and a vapor-emitting and heat-sealable coating adhered thereover, said coating including a heat-activatable, thermoplastic, flexible, normally non-tacky, vinyl resin adhesive and a vapor emitting ingredient consisting essentially of a volatile inhibitor of the corrosion of metals, the weight ratio of said adhesive to said corrosion inhibitor being between 1:1.5 and 8.5:1.5 with the total dry solids coating weight of said adhesive and corrosion inhibitor being between 10 and 40 lbs. per ream of sheet support member equivalent to 500 sheets measuring 24" x 36", said corrosion inhibitor being characterized by having a vapor pressure at least greater than 0.00002 mm. Hg at 21° C. and by being non-reactive with said adhesive.

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