

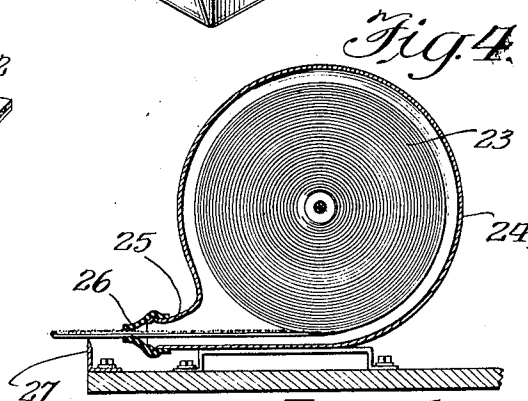
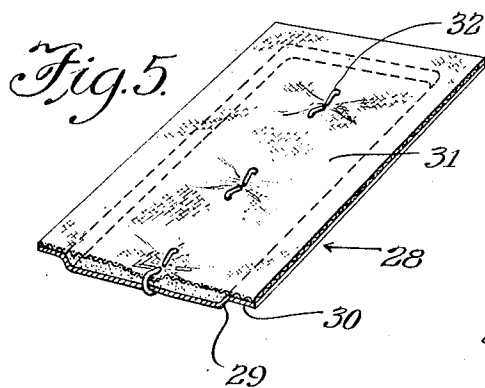
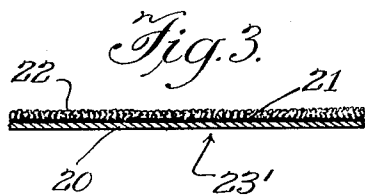
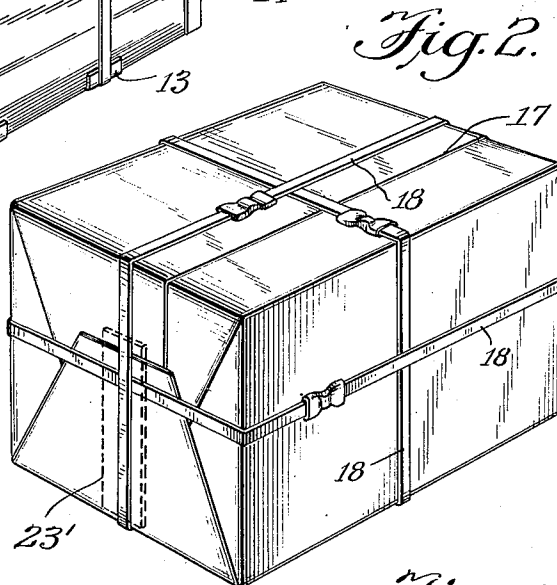
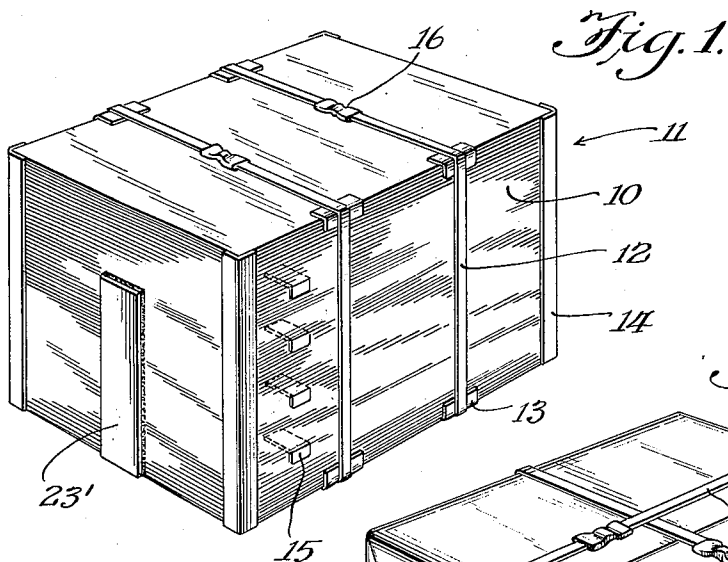
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RUST PREVENTIVE PACKAGING FOR IRON SHEETS AND THE LIKE

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RUST PREVENTIVE PACKAGING FOR IRON SHEETS AND THE LIKE

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Application May 18, 1936, Serial No. 80,325

9 Claims. (Cl. 206—60)

My invention relates to rust-proof packaging for iron sheets or the like. In general, my invention consists in wrapping a bundle of the sheets with a moisture-proof wrapping and enclosing within the wrapped bundle a desiccant for the enclosed moisture and a neutralizer for any enclosed acids, traces of which tend to accelerate rusting or to corrode metal. My invention is also concerned with convenient means for supporting and handling the desiccating and neutralizing materials.

Iron (including steel) sheets are usually shipped from the steel mills flatwise in stacked bundles. Since the sheets are subject to considerable exposure in shipment and may have to lie in storage for some weeks before they are used by the automobile body manufacturers, sign lithographers or other fabricators, it has been the practice to take steps calculated to prevent rusting of the sheets.

The most usual form of rust prevention has been oiling the sheets to leave a protective film of oil. Oiling the sheets has involved considerable additional cost. It has other disadvantages. One is that the oil has to be removed in most instances before the sheets can be used. Another disadvantage is that the lubricating effect of the oil greatly increases the tendency of the sheets to slide relative to each other in the course of handling and as a result of jolting of railway cars. And sand or other small particles of hard foreign matter which may have been lodged between sheets will cause objectionable scratches on the surface if there is sliding between juxtaposed sheets. The tendency of the oiled sheets to slide also makes it more difficult to maintain the rectangular contours of the bundles.

In some instances the bundles of unoled sheets have been wrapped in moisture-proof paper with moisture-proof seals. This is considerably cheaper than oiling, but has not proved satisfactorily positive in preventing rust. Because of the susceptibility of the paper to accidental tearing or perforation, the bundles have sometimes been wrapped with larger tinned sheets. This has not been sufficiently reliable to justify the cost, in most instances. In both the tin and the paper wrappings there has been some incidental seepage of moisture, considerably increased, of course, in the event of puncture. Contraction and expansion of the wrapped bundle, due to subjecting the enclosed air to changes in temperature, have had a bellows-like action in circulating moisture-laden air into the package.

My investigations have led me to the further

conclusions that such wrappings have been ineffective largely because of failure to take into consideration that considerable moisture may be wrapped up in the package originally, together with volatile acids which act as accelerators for rusting and in some instances are themselves corrosive.

In the rust-proof packaging which I have developed to solve this problem, I use a wrapping for the bundle which is fairly moisture-proof consistent with relatively low cost for the wrapper, and I enclose in the wrapped bundle material which acts as a desiccant for the water and as a neutralizer for the objectionable acids.

The quantity of such material enclosed in the package is sufficient to remove from contact with the sheets such moisture and acids as may be originally wrapped up within the package and also to take care of reasonable amounts of infiltration of moisture and atmospheric acids as is likely to occur within the expected time interval before the package is opened for use. Rusting of the iron sheets is prevented primarily by eliminating the moisture within the package. The moisture would act as a catalyst, as well as chemically combining, in forming the various iron oxides and hydroxides which usually constitute rust. Carbon dioxide, in its acid form, will act directly upon the iron and iron oxides and hydroxides to form iron carbonates, which are other usual forms of rust.

Moisture is, of course, quite liable to be present in the atmosphere where the bundles are wrapped. Also, the atmosphere around the steel mills will carry a relatively large content of carbon dioxide and acid forming sulphur compounds resulting from the coal fires, and these will likewise be in the air originally wrapped up within the bundles.

There should also be taken into account the atmospheric acid fumes from the scale-removing pickling bath to which the sheets are subjected before bundling. Thus, in addition to the water and the carbon dioxide in the enwrapped air which directly react on the iron to form rust, there are acids which accelerate rust either by catalysis or by penetration of the initial film of rust which would otherwise itself tend to prevent further rust, or are themselves corrosive. Acid and acid forming compounds included in this group are: the carbon dioxide (in the second of its dual objectionable functions), sulphur compounds including sulphur dioxide, sulphur trioxide, and hydrogen sulphide, chlorine com-

pounds including chlorine and hydrochloric acid and nitrogen compounds, particularly oxides.

The desiccating agent to be wrapped within the package should maintain the moisture content of the enwrapped air safely below the critical point of 60% humidity, but preferably as low as 1%. While the desiccant alone is of material aid in preventing rust, a desiccant alone may not be sufficient for fairly complete protection. Even though the moisture content of the enwrapped air is kept safely below the dew point (taking into consideration subjection to low temperatures), there is a surface film of moisture on the sheets which will form rust with the aid of the catalytic or corrosive acids present. The hygroscopic character of rust will cause it to absorb further moisture, although the moisture content of the air is well below the dew point, and thereby continue the rusting. Thus it becomes important, in addition to removing the moisture from the air, to neutralize the acids.

For the primary rust preventing substance, I prefer to use a mixture of calcium oxide (quick lime) and calcium sulphate (anhydrous gypsum—preferably $2\text{CaSO}_4 \cdot \text{H}_2\text{O}$). The calcium sulphate serves as a desiccant and the calcium oxide as a combined desiccant and neutralizer. Both are readily available in quantities at very low cost and may be conveniently handled, so that the incorporation of my invention in a wrapped package need incur but a practically negligible additional expense to the shipper.

Calcium oxide and calcium sulphate share the further advantage that they can take up a relatively large amount of water and still remain dry; that is, they will not liquefy or become sloppy to handle within the bundle. Very low vapor pressures make them particularly desirable for my purpose.

With calcium oxide, the taking up of moisture from the enwrapped air produces calcium hydroxide; that is, a slaking of the quick lime. The chemical reaction of the calcium oxide with entrapped carbon dioxide produces calcium carbonate, thereby neutralizing the otherwise acid forming effect of the carbon dioxide. The calcium oxide acts upon the traces of hydrochloric acid, to produce calcium chloride (in unobjectionable quantities) and water which latter, in turn, is taken up by the remaining calcium oxide. In a similar way the other objectionable acids are neutralized.

As a substitute for the calcium sulphate described, I contemplate that anhydrous copper sulphate may be used. In that case it would be desirable to keep the copper sulphate out of direct contact with the iron because, if it were dissolved and in contact with the iron, it would result in copper being plated on to the iron. However, since copper sulphate will not dissolve in its own water of crystallization and since the substance may readily be incorporated in the package without danger of its contacting the iron, these objections are not serious. I also contemplate that aluminum trioxide (anhydrous alumina) may also be substituted for the calcium sulphate as the desiccant. Another possible substitute desiccant for my purpose is phosphorus pentoxide preferably mixed with nine parts of an inert filler, such as glass wool or coke dust or clay, and exposed as a thin layer to the circulation of air within the package. Phosphorus pentoxide develops considerable heat when absorbing large amounts of moisture rapidly and the purpose of the filler is to help dissipate the heat and pre-

vent an objectionable high local temperature in the event an unusual amount of moisture should be absorbed at one time.

As a combined desiccant and neutralizer, I contemplate that in lieu of calcium oxide, magnesium oxide or soda lime (an intimate mixture of calcium oxide and sodium hydroxide) or sodium hydroxide may be substituted. In the instance of the sodium hydroxide, it would be desirable to incorporate it mixed with a suitable porous filler to avoid caking and to dilute the substance, concentrated sodium hydroxide being poisonous in that it will burn the hands.

I contemplate that other desiccating and neutralizing substances could be substituted for calcium oxide and calcium sulphate, but most of them would be objectionable for one reason or another. Calcium chloride, which is so frequently used as a desiccant, liquefies readily, is then hard to handle and itself becomes corrosive of metal. Ammonium chloride (sal ammoniac) would have a similar corrosive effect, despite its being a good desiccant. Other excellent desiccants, such as phosphorus pentoxide, lead compounds and metallic magnesium and sodium are prohibitive because of cost, danger in handling and their poisonous nature. Aluminum chloride and any general well-known desiccants containing halogens are objectionable because they would themselves corrode the metal. I prefer further to avoid such desiccating and neutralizing materials as are apt to become dusty and thereby require the cleaning of the sheets, especially before lithographing.

Whether a suitable desiccant and a suitable neutralizer are used together, or whether the two functions are combined in some suitable substance such as calcium oxide, I prefer to enclose also in the wrapped bundle a minor portion of an absorbent or adsorbent such as activated charcoal, activated alumina, or silica gel as a further precaution for taking up carbon dioxide and such miscellaneous acid fumes as may not lend themselves as well to neutralization by the primary neutralizing substance. The relatively high cost of activated carbon, activated alumina and silica gel is one objection to their use to the exclusion of primary desiccants and neutralizers.

In the instance of calcium oxide and calcium sulphate, I prefer to use them in a dry granular form. Where substitute desiccants and neutralizers or combined desiccants and neutralizers are used, I prefer to use the granular dry forms of them also, if possible. The activated carbon or activated alumina or other adsorbent is most conveniently mixed with the desiccant and neutralizer. Where calcium oxide and calcium sulphate is used, a mixture of two parts of calcium oxide, seven of calcium sulphate and one or two of activated charcoal will ordinarily suffice for both summer and winter use.

My packaging may also advantageously be applied to tin plate bundles, especially where the wrapped bundle is not to be opened for some time and may have to be shipped overseas where the salt spray of the sea air seeping into the bundle will act as a corrosive agent and as a catalyst through the pores of the tin plate in the corrosion of the underlying iron sheet. At the pores, the tin and iron set up an electrocouple acting through the moisture and entrapped acids or infiltrating salt spray, electrolytically to rust the underlying iron.

In a somewhat similar way my packaging may be used advantageously in shipping bundles of galvanized sheets. Here the porous zinc coating

and iron set up an electrocouple in the presence of moisture and enwrapped acids, whereby the zinc is corroded to an objectionable zinc compound—probably zinc carbonate and basic zinc carbonate—which discolors the sheets. If this proceeds far enough to eat away the protection of the zinc, the underlying iron is then attacked as in the instance of wrapped iron sheets.

In the accompanying drawing I have illustrated the mechanics of the application of my invention to a bundle of iron sheets and also the preferred expedients for the convenient handling of the enwrapped material;

Fig. 1 is a perspective view of a conventional strapped bundle of sheets prior to wrapping, but showing the addition of a quantity of the desiccating and neutralizing material with its carrier;

Fig. 2 is a similar view of the package after wrapping;

Fig. 3 is a cross section of a backing sheet or carrier for the desiccating or neutralizing substance;

Fig. 4 is a vertical section through a container for a roll of the backing sheet and material, and

Fig. 5 is a perspective view, partly in section, showing a pad as an alternative means for handling the material.

Referring to Fig. 1, the iron sheets 10 are stacked flatwise in a bundle indicated generally at 11, and strapped or wired crosswise adjacent each end as at 12. Angular corner protectors 13 are inserted beneath the straps and angular corner uprights 14 are used to keep the corners of the sheets lined up and to protect the subsequent wrapping from being punctured by corners of sheets. Following the usual custom, the entire bundle of sheets is subdivided into "boxes" (112 sheet groups) by interleaved sheet metal scraps having bent-down protruding ends forming tabs 15. It will be noted that the straps or wires 12, their seals or ties 16, their corner protectors 13, the corner uprights 14 and the tabs 15 all extend somewhat beyond the normal walls of the bundle and tend to increase the air space which will necessarily be enclosed when the bundle is wrapped. I mention this because this air space is a considerable one and one which is necessarily present when a standard bundle is wrapped. That air space will ordinarily, because of its volume, include a substantial amount of moisture content, carbon dioxide and miscellaneous acid fumes, partly from smoke in the atmosphere and partly from the pickling bath. It should also be borne in mind that the sheets themselves are not perfectly flat, hence there is a considerable volume of interleaved air and this is increased somewhat by the spreading effects of the interleaved tabs 15. The package is then wrapped, enclosing a quantity of desiccating material, as will later be described.

The wrapper 17 is preferably two plies of stout crepe paper bound together by a thin layer of tar, asphalt or similar material to render the wrapper moisture-proof. The crepe paper allows a certain degree of stretch calculated to preclude likelihood of tearing or puncture. Single layers of tarred, waxed or chlorinated rubber-treated paper might be substituted. The overlapped edges of the paper occasioned by the wrapping, are sealed by a moisture-proof glue or other adhesive, such as alkyd resins, Hercose, or tornesite. If desired for further protection, burlap may be laid over the paper or constitute an outer layer for the paper. The sealed package is preferably reasonably moisture-proof, but

I recognize that in practice it is impossible to rely upon the wrapping being completely impervious to moisture and, therefore, the quantity of desiccating material enclosed should be ample to take up small quantities of water which can be expected to seep into the package through faulty seals, imperfections in the wrapping paper, or accidental punctures or small tears.

After wrapping and sealing, the package, as is customary with wrapped packages, is again strapped as indicated at 18.

The desiccating and neutralizing material can be poured loosely into the package as it is wrapped. I have, however, provided a more convenient solution to the problems of handling the material. It is preferable that it be conveniently handled, that it does not come in loose contact with the sheets where it might get between them, requiring subsequent cleaning of the sheets before use, that it be supported within the package in an advantageous position free to circulation of the air, that it be readily metered in predetermined quantities depending upon the size of the bundle or severity of the conditions which the bundles may have to withstand, that it be readily removable from the package in unwrapping, and that the material be easily stored in a hermetically sealed container to protect it from moisture absorption until it is ready to be incorporated in a package. I have secured all of these desirable qualities by the mechanically simple expedient of applying the material in granular form to a cheap paper backing somewhat after the fashion of sand paper.

Referring to the detail cross-section of Fig. 3, I use as a backing a strip of paper 20 some 5" or 6" in width and of about the weight of ordinary kraft wrapping paper. To one surface of this is applied a coating of adhesive 21 preferably such as a thermoplastic resin not affected by water. While the adhesive is still tacky, the strip is passed through a bin or vat of the granular material 22 so that the paper emerges with a layer of the material permanently adhering thereto. This paper strip may be fed from a continuous roll for such treatment and then rewound on a roll 23 shown in Fig. 4. These rolls may be shipped and stored in sealed drums or securely wrapped in moisture-proof paper.

For use in the wrapping room of the iron sheet mill, I prefer to provide an air-tight casing 24 for an individual roll 23. The casing 24 is adapted to be mounted on the top of a table, counter or portable stand conveniently near where the wrapping is to be done. From the roll, the free end of the strip is protruded through a mouth-like portion 25 of the casing and past rubber lips 26 which tightly engage the sides of the strip to make a substantially air-tight seal there-against to protect the body of the roll. As a bundle of sheets is being wrapped, the operator may pull out a desired length of strip from the roll and tear it off with the aid of a conveniently located knife blade 27. The severed strip 23' bearing a layer of the material is then inserted within the wrapping. Preferably, as indicated in Fig. 1, it is placed upright against a side or end of the bundle of sheets as it is being wrapped. Two shorter strips, one at each end of the bundle, should prove more effective than a single sheet of twice the length at only one point in the bundle.

This sand paper like mounting of the granular desiccant permits a quick and easy method of metering the amount of material enclosed with

each package, because the amount of material is in direct proportion to the length of strip 23' enclosed in the bundle. It makes it unnecessary to keep on hand an assortment of various sizes of pads or other carrying devices having predetermined quantities of material in each unit.

In Fig. 5 I have illustrated a pad 28 as an alternative means of handling predetermined quantities of the material for convenient insertion in the wrapped bundle. This constitutes a rectangular backing sheet 29 centrally embossed to leave an elevated flat rim 30. The depressed or embossed region 29 is filled flatwise with a predetermined quantity of the granular material, the face of the rim 30 is coated with an adhesive, and a rectangular top sheet 31 of cheese cloth or other porous material is applied over the backing with the margins of the sheet 31 adhering to the rim 30. If the pads are relatively large, the center field may be quilted by wire staples 32 better to retain the granular material in position. A quantity of such pads 28 would be kept in an air-tight container and removed as required for the insertion of one or two pads in each bundle.

Where the material is of a nature which is apt to dust, it is advisable to envelop the material in sheets of relatively loose felt, jute, wool shoddy or other cheap fibrous materials from which the moisture has been removed. Pads wherein the dusty material is enveloped by such fibrous substances will effectively prevent the dust from getting to the iron sheets and from getting between the sheets where they might form surface scratches. Such fibrous substances will themselves have the incidental function of desiccants, many of them absorbing better than 10% of their own weight in moisture.

While I have disclosed these specific embodiments of my invention, I contemplate that many changes and substitutions may be made without departing from the scope or spirit of my invention. Particularly, I contemplate that the substitute desiccating and neutralizing materials mentioned may be employed with varying degrees of success, subject to the objections noted, and that other known desiccants, neutralizers, absorbents and adsorbents may be substituted.

I claim:

1. A rust preventive shipping package for flat iron sheets comprising a wrapper of moisture-proof sheet material enveloping and sealing a solid stack of the sheets, the wrapper being arranged about the stack to leave thin flat air-communicating passageways between the wrapper and the sheets at a plurality of edges thereof without thereby substantially increasing the over-all dimensions of the package, the wrapper initially enveloping moisture-laden and rust-accelerating acid fume-laden air, a quantity of calcium oxide enclosed and remaining within the package, and supporting means for holding the calcium oxide collected in a regionally concentrated flat body against general dissemination throughout the entirety of the package and against ingress between the sheets and for exposing the calcium oxide to the air communicating with said passageways, whereby the calcium oxide may take up moisture from substantially all air within the package and neutralize said acids carried thereby, the calcium oxide being in a dry sub-divided form of the class comprising crystalline, granular and powdered forms.

2. A rust preventive shipping package for flat iron sheets comprising a wrapper of moisture-

proof sheet material enveloping and sealing a solid stack of the sheets, the wrapper being arranged about the stack to leave thin flat air-communicating passageways between the wrapper and the sheets at a plurality of edges thereof without thereby substantially increasing the over-all dimensions of the package, the wrapper initially enveloping moisture-laden and rust-accelerating acid fume-laden air, a quantity of calcium oxide and calcium sulphate enclosed and remaining within the package, and supporting means for holding the calcium oxide and calcium sulphate collected in a regionally concentrated flat body against general dissemination throughout the entirety of the package and against ingress between the sheets and for exposing the calcium oxide and calcium sulphate to the air communicating with said passageways, whereby the calcium oxide and calcium sulphate may take up moisture from substantially all air within the package and neutralize said acids carried thereby, the calcium oxide and calcium sulphate being in a dry sub-divided form of the class comprising crystalline, granular and powdered forms.

3. A rust preventive shipping package for flat iron sheets comprising a wrapper of moisture-proof sheet material enveloping and sealing a solid stack of the sheets, the wrapper being arranged about the stack to leave thin flat air-communicating passageways between the wrapper and the sheets at a plurality of edges thereof without thereby substantially increasing the over-all dimensions of the package, the wrapper initially enveloping moisture-laden and rust-accelerating acid fume-laden air, a conditioning substance comprising a major portion of material of the group comprising calcium oxide and calcium sulphate, together with a minor portion of an adsorbent of the class comprising activated carbon and activated alumina, enclosed and remaining within the package, and supporting means for holding the conditioning substance collected in a regionally concentrated flat body against general dissemination throughout the entirety of the package and against ingress between the sheets and for exposing the conditioning substance to the air communicating with said passageways, whereby the conditioning substance may take up moisture from substantially all air within the package and neutralize said acids carried thereby, the conditioning substance being in a dry sub-divided form of the class comprising crystalline, granular and powdered forms.

4. A rust preventive shipping package for flat iron sheets comprising a wrapper of moisture-proof sheet material enveloping and sealing a solid stack of the sheets, the wrapper being arranged about the stack to leave thin flat air-communicating passageways between the wrapper and the sheets at a plurality of edges thereof without thereby substantially increasing the over-all dimensions of the package, the wrapper initially enveloping moisture-laden and rust-accelerating acid fume-laden air, a desiccant and acid neutralizer, enclosed and remaining within the package, and supporting means for holding the desiccant and acid neutralizer collected in a regionally concentrated flat body against general dissemination throughout the entirety of the package and against ingress between the sheets and for exposing the desiccant and acid neutralizer to the air communicating with said passageways, whereby the desiccant and acid neutralizer may take up moisture from substantially

all air within the package and neutralize said acids carried thereby, the desiccant and acid neutralizer being in a dry sub-divided form of the class comprising crystalline, granular and powdered forms.

5 5. A rust preventive shipping package for flat iron sheets comprising a wrapper of moisture-proof sheet material enveloping and sealing a solid stack of the sheets, the wrapper being arranged about the stack to leave thin flat air-communicating passageways between the wrapper and the sheets at a plurality of edges thereof without thereby substantially increasing the over-all dimensions of the package, the wrapper initially enveloping moisture-laden air, a desiccant for taking up the moisture enclosed and remaining within the package, and supporting means for holding the desiccant collected in a regionally concentrated flat body against general dissemination throughout the entirety of the package, against ingress between the sheets, and exposed to the air communicating with said passageways, whereby the desiccant may take up moisture from substantially all air within the package, the desiccant being in a dry sub-divided form of the class comprising crystalline, granular and powdered forms.

6. A rust preventive shipping package for flat iron sheets comprising a wrapper of moisture-proof sheet material enveloping and sealing a solid stack of the sheets, the wrapper being arranged about the stack to leave thin flat air-communicating passageways between the wrapper and the sheets at a plurality of edges thereof without thereby substantially increasing the over-all dimensions of the package, the wrapper initially enveloping moisture-laden and rust-accelerating acid fume-laden air, a desiccant and acid neutralizer, enclosed and remaining within the package, and supporting means for holding the desiccant and acid neutralizer collected in a regionally concentrated flat body against general dissemination throughout the entirety of the package against ingress between the sheets, and exposing the desiccant and acid neutralizer to the air communicating with said passageways, whereby the desiccant and acid neutralizer may take up moisture from substantially all air within the package and neutralize said acids carried thereby, the desiccant and acid neutralizer being in a dry sub-divided form of the class comprising crystalline, granular and powdered forms, said desiccant and acid neutralizer, and the products of its neutralization of the acids and the products of its chemical reaction with the moisture all being

non-corrosive of rusting and non-corrosive of the sheets.

7. A rust preventive shipping package for flat iron sheets comprising a wrapper of moisture-proof sheet material enveloping and sealing a solid stack of the sheets, the wrapper being arranged about the stack to leave thin flat air-communicating passageways between the wrapper and the sheets at a plurality of edges thereof without thereby substantially increasing the over-all dimensions of the package, the wrapper initially enveloping moisture-laden and rust-accelerating acid fume-laden air, and a conditioning member enclosed flatwise in one of said passageways, the conditioning member comprising a strip of backing sheet material, a film of moisture-proof adhesive on one surface of the backing sheet, and a layer of granular desiccating and acid-neutralizing material adhered to the sheet by the adhesive and open to the circulation of air in the passageways.

8. A corrosion preventive shipping package for flat metal sheets comprising a wrapper of moisture-proof sheet material enveloping and sealing a substantially solid stack of the sheets, the wrapper being arranged about the stack to leave air spaces between the wrapper and the sheets without thereby substantially increasing the over-all dimensions of the package, a desiccant wrapped within the package for taking up from the enclosed air moisture within the package, and means for holding the desiccant in exposed communication with the air in the air spaces but against general dissemination throughout the entirety of the package whereby the desiccant will take up moisture from substantially all the air within the package and withhold it from the sheets.

9. A corrosion preventive shipping package for flat metal sheets comprising a wrapper of moisture-proof sheet material enveloping and sealing a substantially solid stack of the sheets, the wrapper being arranged about the stack to leave air spaces between the wrapper and the sheets, a desiccant and acid neutralizer wrapped within the package, and means holding the desiccant and acid neutralizer in exposed communication with the air in the air spaces but against general dissemination throughout the package, whereby the desiccant and acid neutralizer will take up moisture from the air within the package and withhold it from the sheets and will neutralize acids borne by the air within the package.

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