

May 22, 1962

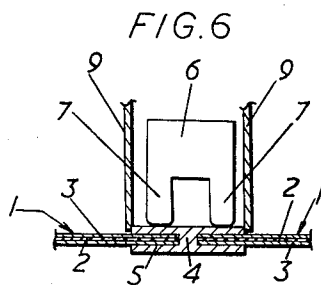
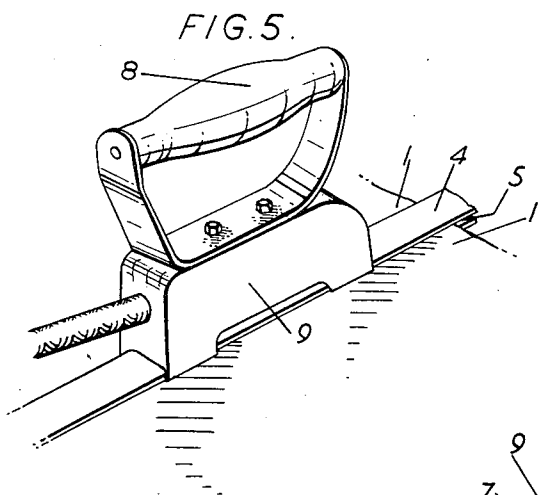
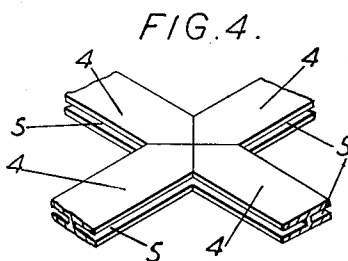
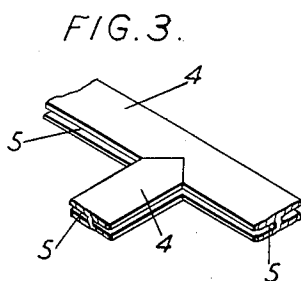
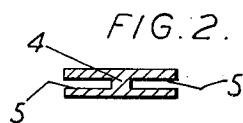
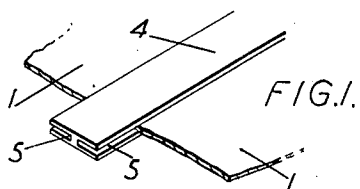
D. GONDA ET AL

3,035,956

FLEXIBLE PROTECTIVE COVERING SHEET MATERIAL

Filed Jan. 2, 1958

6 Sheets-Sheet 1



May 22, 1962

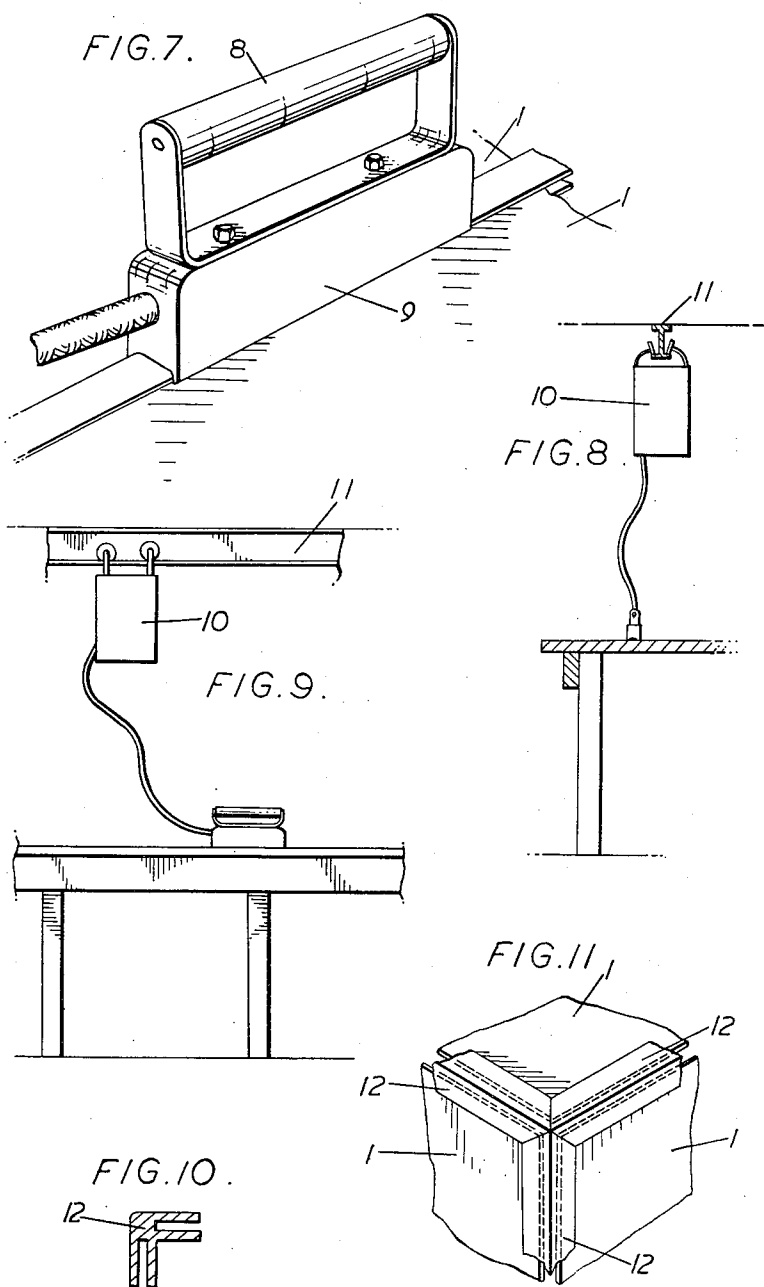
D. GONDA ET AL

3,035,956

FLEXIBLE PROTECTIVE COVERING SHEET MATERIAL

Filed Jan. 2, 1958

6 Sheets-Sheet 2



May 22, 1962

D. GONDA ET AL

3,035,956

FLEXIBLE PROTECTIVE COVERING SHEET MATERIAL

Filed Jan. 2, 1958

6 Sheets-Sheet 3

FIG. 12.

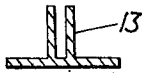


FIG. 13.

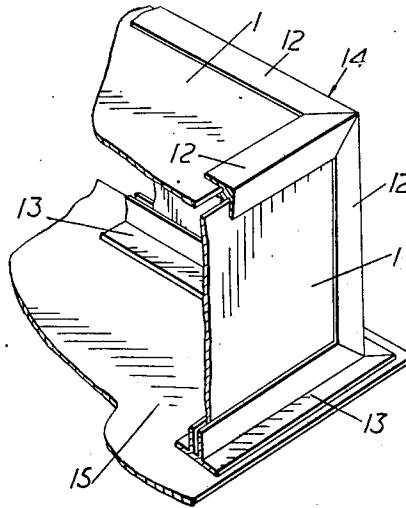


FIG. 14.

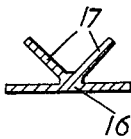


FIG. 15.

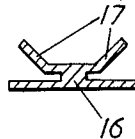


FIG. 16.

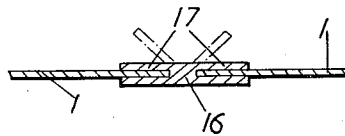


FIG. 17.

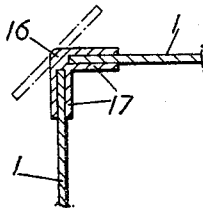
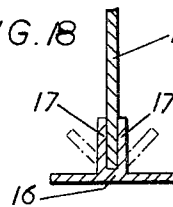


FIG. 18.



May 22, 1962

D. GONDA ET AL

3,035,956

FLEXIBLE PROTECTIVE COVERING SHEET MATERIAL

Filed Jan. 2, 1958

6 Sheets-Sheet 4

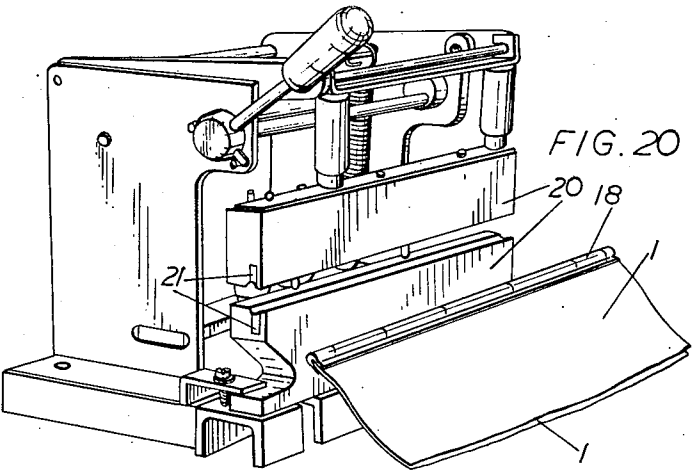


FIG. 19.

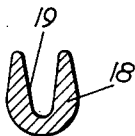


FIG. 21.

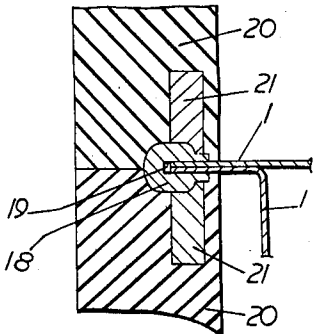
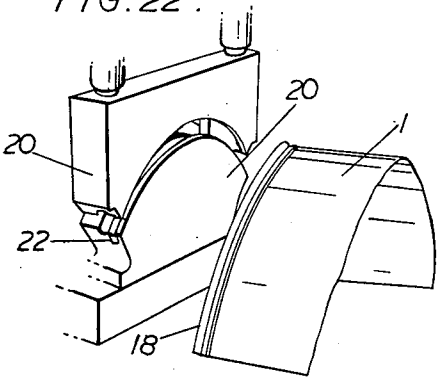


FIG. 22.



May 22, 1962

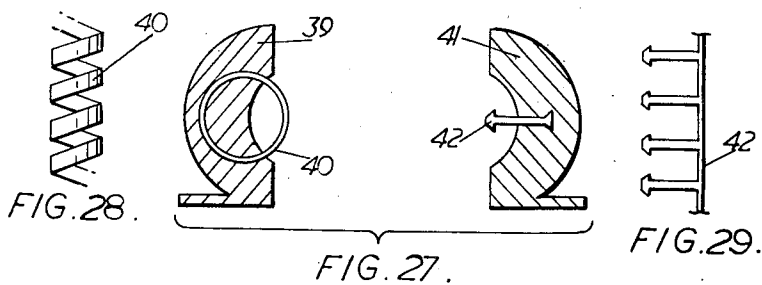
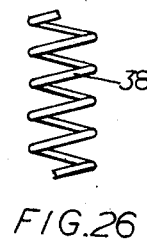
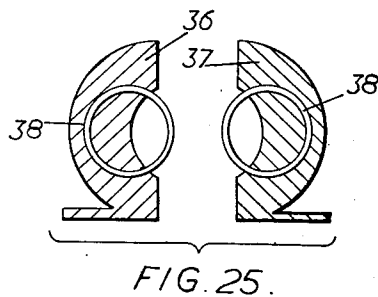
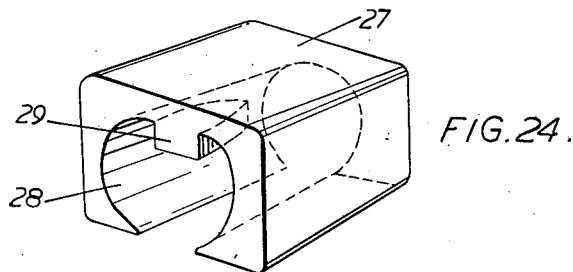
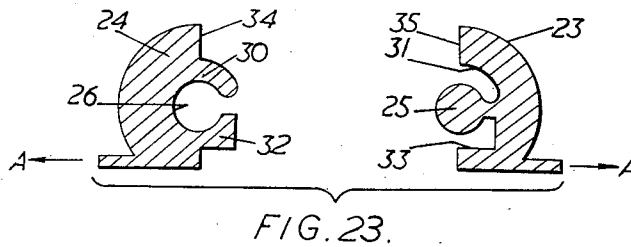
D. GONDA ET AL

3,035,956

FLEXIBLE PROTECTIVE COVERING SHEET MATERIAL

Filed Jan. 2, 1958

6 Sheets-Sheet 5



May 22, 1962

D. GONDA ET AL

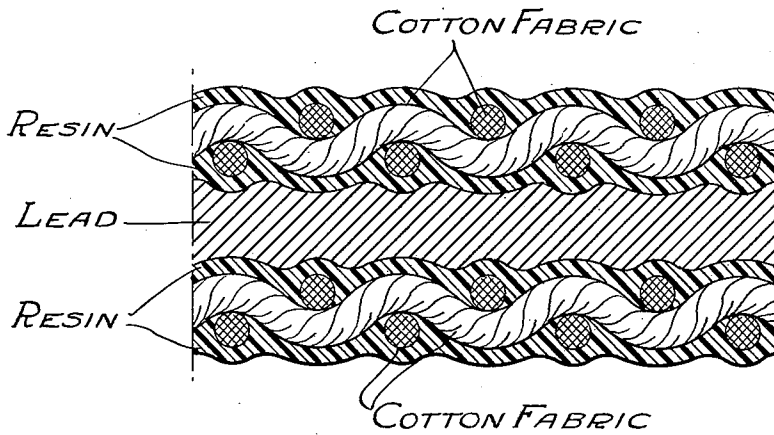
3,035,956

FLEXIBLE PROTECTIVE COVERING SHEET MATERIAL

Filed Jan. 2, 1958

6 Sheets-Sheet 6

Fig. 30.



1

3,035,956

FLEXIBLE PROTECTIVE COVERING SHEET MATERIAL

Desire Gonda, Sittingbourne, and Edwin Lawrence Hawley, Herne Bay, England, assignors to E.P.S. (Research & Development) Ltd., Sittingbourne, England, a British company

Filed Jan. 2, 1958, Ser. No. 706,782

Claims priority, application Great Britain Jan. 2, 1957
6 Claims. (Cl. 154—50)

This invention concerns a new or improved flexible material, particularly suitable for use as a protective covering material for packaging and preservation purposes.

Valuable items, such as, for example, machine tools, aircraft components, engines of all kinds, and electrical and electronic apparatus, which have frequently to be transported over great distances or stored for long periods, are often subject to corrosion or other deterioration during transport or storage. Such deterioration is caused mainly by the action of moisture or moisture vapour on the items in question and under very damp climatic conditions the extent of deterioration may be considerable.

It is therefore desirable that such items should be enclosed in a covering which is proof against moisture and moisture vapour and several protective covering materials have been used or proposed for this purpose. Unfortunately, none of these materials has proved to be entirely satisfactory.

Thus, one kind of material which has been used to form a protective covering consists of a wrappable medium, such as cloth, kraft paper or the like, treated with a synthetic water proofing compound. The disadvantages of such material are that it is not adequately proof against moisture vapour and not robust enough to remain water-proof when folded and subjected to frequent handling.

A further kind of protective covering material used consists of a metal foil sandwiched between two layers of paper or fabric, either untreated or treated with a synthetic water-proofing compound. Where the said paper or fabric is treated with a synthetic water-proofing compound, the latter is in some cases so applied as to provide, for the paper or fabrics, surfaces which are resistant to damage by abrasion and the like and which enable a heat sealing technique to be used for joining two parts of the material together. Such material can be pre-fabricated or tailored to the shape of the item to be protected. In a modification of the material just referred to, a sheet of metal foil is backed with a scrim or cloth and the front surface of the metal foil is coated with a film, i.e. an extremely thin layer, of a thermoplastic material, which may be as thin as 0.001 inch.

The use of metal foils in protective covering materials does afford more protection against moisture vapour as compared with materials not using such metal foils, but the metal foils previously used, principally aluminium foil, copper foil and foils of aluminium alloys or copper alloys, are fairly brittle and are not free from pin hole apertures. Also, after a few creasing or crumpling actions, such foils tend to crack or become further punctured by the formation of pin hole apertures.

A further protective covering material which is used is one which is not pre-fabricated, but is produced in situ on the item to be enclosed by the material. Such material is formed by stretching a web of suitable material over the item concerned and then spraying thermoplastic compounds onto the said web so as to build upon the latter a substantially strong coating reasonably proof against moisture vapour. The process of forming this kind of material has been termed "cocooning." Apart from the obvious disadvantage of not being pre-fabricated, the

2

material just referred to has the further disadvantage that the majority of suitable thermoplastic compounds do not give complete proofing against moisture vapour.

It will be appreciated from the foregoing description of known protective covering materials and the disadvantages of the same that the ideal material for packaging and preserving an item liable to corrosion or other deterioration under the action of moisture or moisture vapour would be a tough pre-fabricated flexible material which is completely proof against moisture and moisture vapour even after being repeatedly folded or crumpled and is capable of being easily joined to another part of the same material in a moisture and moisture proof manner, e.g. by heat sealing.

It is an object of this invention to provide a protective covering material which has the properties just specified for the ideal material or comes closer to possessing such properties than any previously used or proposed material.

According to this invention there is provided a flexible protective covering sheet material comprising a layer of lead foil and a sheet of fabric reinforced flexible corrosion resistant heat-sealable material having a thickness of not less than 0.01 inch adhered to each side of the said foil.

We have found that a flexible protective covering sheet material according to this invention may be repeatedly folded or crumpled without cracking or puncturing of the foil. Further, since lead is the most corrosion-resistant of common metals, the material according to this invention is more corrosion-resistant than known flexible protective covering sheet materials. The incorporation of lead in the material according to this invention may also increase the protection of the item enclosed in the material against radio-active "fall out" following an atomic or thermo-nuclear explosion.

Suitable flexible corrosion-resistant heat-sealable materials for forming the material according to this invention are polyvinyl chloride resin and copolymers of polyvinyl chloride.

According to a further aspect of this invention, there is provided a method of forming a flexible protective covering sheet material, such method comprising forming two sheets of fabric reinforced flexible corrosion-resistant heat-sealable material and adhering the same to lead foil, one of said sheets to each side of the latter, by applying a suitable adhesive between the said sheets and lead foil and pressing the same together.

Although the said adhesive may be applied either to the lead foil or to the fabric reinforced sheets alone, preferably the adhesive is applied to both the lead foil and fabric reinforced sheets.

According to a further feature of this invention, the adhesive used to secure the said sheets to the lead foil may conveniently be an adhesive, preferably a fire-resistant synthetic adhesive, having a good preliminary tack.

Advantageously the said adhesive is a solution of the combination of phenolformaldehyde and that synthetic rubber compound known in the trade as "Hycar."

According to a still further feature of this invention, the fabric used to reinforce the said sheets may be a natural fabric such as cotton, silk or any other fabric formed from vegetable or animal fibres or a synthetic fabric such as rayon or Terylene (R.T.M.).

Apart from reinforcing the said sheets, the incorporation of a fabric in such sheets also has the further advantage that, due to the slightly uneven surface possessed by the fabric, when the said sheets and lead foil are pressed together, the lead foil is slightly embossed or corrugated and is thereby rendered more flexible.

Preferably the material according to this invention is formed by first forming the said fabric reinforced sheets

and then adhering such sheets to the lead foil. If desired, however, the material may alternatively be formed by coating, e.g. using a spreading process, one side of a sheet of the selected fabric with a paste adapted to form, on the application of heat and pressure, the said corrosion resistant heat-sealable material, by then applying the adhesive to the fabric side of the coated fabric sheet and to one side of the lead foil, by hot calendering the assembly of coated fabric sheet and lead foil and finally repeating the process to apply a second sheet of coated fabric to the other side of the lead foil. Advantageously each said hot calendering operation is followed by a cold calendering operation.

The paste used desirably comprises polyvinyl chloride and/or a polyvinyl chloride copolymer mixed with a plasticiser and heat and light stabilisers.

Conveniently the plastic also includes pigments, for example to render the material opaque to ultra-violet rays and, also conveniently, the paste is treated so as to be non-inflammable and resistant to the spread of flames.

This invention also includes a protective covering, e.g. a bag or other container, tailored from material according to this invention.

Since the sheets adhered to the lead foil are formed of a heat sealable material, a piece or part of a piece of flexible protective covering sheet material according to this invention may easily be joined in a manner proof against moisture or moisture vapour to another piece or part of such material and thus a covering for an item to be protected may readily be tailored to suit the particular shape of such item and completely to enclose the latter.

Although two pieces of material according to this invention or two parts of a single piece of such material may be joined by overlapping the said pieces or parts and heat sealing the same together, with a reinforcement if desired, preferably, one or more jointing members formed of a corrosion-resistant heat-sealable material compatible with that used to form the reinforced sheets is or are inserted at the junction of the two pieces or parts to be joined and the latter are heat sealed to the said jointing members or members.

Thus, according to a further aspect of this invention, there is provided a method of joining two pieces of heat-sealable material, such method comprising locating each of the said pieces in a groove in a jointing member comprising an extruded strip of a heat-sealable extrudable material and joining the said pieces to said strip by the application of heat and pressure.

The said two pieces of material to be joined may be located in separate grooves in the jointing member or, alternatively, in a single groove in the latter. In the latter case, the two pieces of material are heat-sealed together as well as being heat-sealed to the jointing member.

Extremely efficient heat-sealing of pieces of material according to this invention may be achieved by using radio frequency dielectric heating since the lead foil of the two pieces to be joined may be earthed by capacitive coupling and the output from a radio frequency generator supplied to two electrodes which are electrically connected together and are applied to the jointing member, one adjacent each of the said pieces. Alternatively, the potentials of the electrodes may form a balanced system about earth potential.

It is often desired that some items which have to be protected for long periods against corrosion or other deterioration should be able to be inspected at intervals throughout such period. Often, with protective covering materials used hitherto, such an inspection has required that the protective covering be destroyed so that it has subsequently to be renewed.

It is a further aspect of this invention to provide a protective covering which can easily be opened and resealed again. Thus according to a still further aspect of this invention, there is provided a protective covering formed of a flexible material according to this invention

and incorporating one or more moisture vapour-tight, water-tight, air-tight and light-tight slide fasteners.

In order that this invention may more readily be understood, reference will now be made, by way of example, to the accompanying drawings, in which:

FIGURE 1 is a perspective view showing the joining together of two coplanar pieces of material according to this invention by means of an extruded jointing member:

FIGURE 2 is a cross-section of the jointing member of FIGURE 1;

FIGURES 3 and 4 are perspective views showing how jointing members of the form illustrated in FIGURES 1 and 2 may be mitered and used to form joints between several pieces of material according to this invention;

FIGURE 5 is a perspective view of a manually propelled sealing tool for use in joining two pieces of material using the jointing member of FIGURES 1 and 2;

FIGURE 6 is a fragmentary cross-section through the tool of FIGURE 5;

FIGURE 7 is a perspective view of a second form of manually propelled sealing tool;

FIGURES 8 and 9 are respectively an end elevational view and a side elevational view of an installation using the tool of FIGURE 7;

FIGURE 10 is a cross-section through a corner jointing member for use in forming the corner of a container;

FIGURE 11 is a perspective view showing an alternative method of forming a corner of a container;

FIGURE 12 is a cross-section through a base jointing member;

FIGURE 13 is a perspective view showing the use of the base jointing member of FIGURE 12;

FIGURES 14 and 15 are cross-sections of two forms of jointing members which may be used selectively as planar, corner and base jointing members;

FIGURES 16, 17 and 18 show the three uses of the jointing members of FIGURES 14 and 15;

FIGURE 19 is a cross-section of a further jointing member for use in joining together two pieces of material according to this invention;

FIGURE 20 is a perspective view of a sealing machine having straight electrodes and for use in joining two pieces of material together using the jointing member of FIGURE 19;

FIGURE 21 is a fragmentary cross-section through the electrodes of the machine of FIGURE 20;

FIGURE 22 is a fragmentary perspective view of a sealing machine similar to that shown in FIGURE 21, but having curved electrodes;

FIGURE 23 is a cross-section through one form of slide fastener suitable for use in a container made from material according to this invention;

FIGURE 24 is a perspective view of a slider for use in opening and closing the fastener of FIGURE 23;

FIGURE 25 is a cross-section of a second form of slide fastener suitable for use in a container made from material according to this invention;

FIGURE 26 is a plan view of the metal insert included in each part of the slide fastener of FIGURE 25;

FIGURE 27 is a cross-section of a third form of slide fastener suitable for use in a container made from material according to this invention;

FIGURES 28 and 29 are plan views of the metal inserts included in the two parts of the slide fastener of FIGURE 27; and

FIGURE 30 is an enlarged view illustrating the material with the fabric impressed into the foil layer.

In the drawings, the flexible protective covering sheet material according to this invention illustrated in various figures and indicated by the reference 1 will, by way of example, be assumed to comprise a layer of lead foil 2 having a thickness of about 0.003" to each side of which is adhered, by a synthetic adhesive formed of a solution of the combination of phenolformaldehyde and the synthetic rubber compound known in the trade as "Hycar,"

5

a layer 3 of woven cotton fabric reinforced polyvinyl chloride resin having a thickness of about 0.014" or 0.015".

The method used to form this material may advantageously be as follows:

Firstly a woven sheet of cotton fabric is combined with a sheet of calendered polyvinyl chloride resin. Adhesive is then applied to the fabric side of the combined cotton fabric and polyvinyl chloride sheet and to one side of the lead foil. The adhesive coated faces of the two materials are then brought together and hot calendered. Subsequently the process is repeated to apply a second sheet of cotton reinforced polyvinyl chloride to the other side of the lead foil.

The hot calendering is carried out at a minimum temperature of 250° F. and the calender rolls, the rolls feeding the foil and cotton reinforced polyvinyl chloride sheets and the rolls taking up the assembly formed are synchronised to a single speed so that no relative stretching occurs of the layers forming the assembly.

Instead of applying the two sheets to the lead foil one after the other, as above described, both sheets may, if desired, be applied at the same time.

The composition of said polyvinyl chloride sheet used in the manufacture of the hereinbefore described material may be varied to suit the particular purpose to which the material is to be put. Thus, where the cold flow and cold flexibility characteristics of the material are required to be good, a sebaceous type of plasticiser may be used, and, where the material has to be exposed for long periods to tropical sunlight, the pigments used may be such as to render the material resistant to ultra violet rays and may thus be selected mainly from the dark colour range, carbon black being a good pigment for this purpose.

Since the said sheets adhered to the lead foil are formed of polyvinyl chloride, a piece or part of a piece of the above described flexible protective covering sheet material according to this invention may easily be joined in a manner proof against moisture or moisture vapour to another piece or part of such material and thus a covering for an item to be protected may be tailored to suit the particular shape of such item and completely to enclose the latter.

Although two pieces of material according to this invention or two parts of a single piece of such material may be joined by overlapping the said pieces or parts and heat sealing the same together, with a reinforcement if desired, preferably, one or more jointing members formed of a corrosion-resistant heat-sealable material comparable with the polyvinyl chloride resin used to form the cotton reinforced sheets is or are inserted at the junction of the two pieces or parts to be joined and the latter are heat sealed to the said jointing member or members.

FIGURES 1 and 2 illustrate a suitable jointing member 4 which comprises an extruded strip of polyvinyl chloride resin having therein two longitudinal grooves 5 each adapted to receive a different one of the two pieces or parts to be joined.

In this case the pieces or parts of material to be joined are co-planar, or substantially co-planar, and the strip has a somewhat squat I-shaped cross-sectional form. It will be appreciated that, where, however, the pieces or parts of material are to be joined so that their planes are at an angle to one another, the said jointing member could comprise a strip having two longitudinal parts or flanges diverging from one another at the desired angle and having longitudinal grooves in their outer edges. A particularly useful jointing member would be one having an L-shaped cross-section and having a longitudinal groove in the free edge of each flange of the member. Such a member would enable two piece or parts of material to be secured together with their planes at right angles to one another.

Where, in the construction of a protective covering

6

from material according to this invention, two or more of the jointing members 4 meet, they may easily be mitred and heat-sealed together to produce a secure and sealed joint as shown in FIGURES 3 and 4.

Although sealing of two pieces or parts of material according to this invention together or to a jointing member may be carried out by any method of applying heat, e.g. by induction heating or by hot air, advantageously high frequency dielectric heating is used.

Where high frequency heating is used for sealing two pieces or parts of material together, the said two pieces or parts may be overlapped where the seal is to be made and moved, relatively to a live electrode located between the overlapping parts of the material, in a direction extending from the forward end of the electrode to the rear end thereof, pressure being applied to the overlapped parts of the material, in a region immediately rearwardly of the rear end of the said electrode.

Advantageously, the electrode in this case is of flat shoe form. However, the electrode could, if desired, vary in shape, depending on the type of seal required, i.e. a broad knife blade electrode could be used to produce a seal right up to the edge of the sheets, and to a depth depending on the distance that the knife blade is inserted between the sheets.

At the very high frequency used for dielectric heating the capacity effect of the large surface area of the lead foil laminate compared with the small area of the live electrode causes the lead foil to behave as a virtual earth and the high frequency heating field is generated between the live electrode and each lead laminate, i.e. only where the polyvinyl chloride is required to be softened for the welding. Once the polyvinyl chloride has been sufficiently softened where desired, it only remains to unite the two layers under slight pressure and allow them to cool, preferably still under pressure. This is conveniently achieved by using suitably shaped follow-up pressure bars or a series of paired follow-up pressure rollers.

Where an extruded jointing member such as is shown in FIGURES 1 and 2 is used to form a joint between two pieces or parts of material, the said member is preferably laid on a suitably shaped supporting surface and a high frequency sealing tool guided along the member so as to press the same towards said supporting surface.

Such a tool is illustrated in FIGURES 5 and 6. Referring to these figures, it will be seen that the tool comprises a radio frequency dielectric heating head 6 having two parallel electrode limbs 7 spaced apart by a distance such that one limb registers with each of the grooves 5 in a member 4 when the tool is placed in position on such member.

The tool is also provided with a handle 8 whereby an operator may manually traverse the tool along and apply pressure to the jointing member and a guard 9 for the head 6. Advantageously this guard as shown engages the edges of the extruded strip member 4 and acts to guide the tool along the latter. The guard 9 is conveniently transparent and may be advantageously formed of methylmethacrylate resin. The guard 9 may, if desired, be spring loaded so that the tool can run over a joint between two jointing members 4 without having to be lifted off from the member on one side of said joint and replaced on the member on the other side of said joint.

The tool may include a microswitch in the heater circuit and normally biased in a direction opening the said circuit, but positioned to close said circuit only when the electrode limbs of the tool are in contact with a jointing member.

FIGURE 7 illustrates a second form of tool which may be used in the jointing of two piece of material using jointing members of the form shown in FIGURES 1 and 2. This tool, like that of FIGURE 5 includes a handle 8 and guard 9. In use, the tool is placed at the position to be welded, held under pressure while the radio frequency

field is applied and pressure maintained for the required time to consolidate the weld after switching off the field. The tool is then moved on and replaced on the work to overlap the weld just made by a small amount. The tool may be held in the hand or advantageously fitted to a hand press applying a known controlled pressure.

The radio frequency generator 10 for the heater electrodes of either of the tools illustrated may conveniently be suspended, as shown in FIGURES 8 and 9, from an overhead track or rail 11 along which the generator may be traversed as necessary.

If desired, the tool may comprise two pairs of electrodes, one pair for each of the grooves 5 in the jointing member 4.

As in the already mentioned case of the sealing of two pieces or parts of material according to this invention together in overlapping relation, when using a tool as above described for sealing such material to a jointing member 4, the lead foil 2 acts as a virtual earth and the high frequency field is generated between the live electrodes and the foil of each piece or part of material. Since the live electrodes are always applied to an outer surface, they can be completely shrouded, e.g. by using the guard 9.

If desired, prior to sealing the material to a jointing member, such material may be connected thereto or "tacked" in a selected few places by spot welding.

The corners of a protective covering may also be formed by jointing members mitred and heat-sealed together. For example, in forming a rectangular parallelepipedal box-like covering from six panels of materials, each pane forming a side of said covering and being secured to adjacent panels along edges of the covering, the jointing members may conveniently be of an L-shaped cross-section as shown at 12 in FIGURE 10 and the three mutually perpendicular jointing members meeting at each corner may be mitred and heat-sealed together as shown in FIGURE 11. The said corners may be reinforced by flexible corner pieces secured thereover. Alternatively, moulded corner jointing members of a mouldable heat-sealable material may be used, if desired.

It is advantageous in certain applications to build a protective covering on an existing structure, as for example, a ship's deck. In this case the jointing member 13 illustrated in FIGURE 12 may conveniently be used. FIGURE 13 shows how a covering 14 may be formed on an existing structure 15 using jointing members 13 to connect sheets of material 1 to the structure 15 and jointing members 12 to connect adjacent sheets of material 1.

Other suitable jointing members are shown in section in FIGURES 14 and 15. These members comprise a web 16 from which two flanges 17 outwardly diverge. Such members could be made to serve three separate functions; i.e. for joining flat sheets as shown in FIGURE 16; for forming corners as shown in FIGURE 17 or for attaching a container to a support as shown in FIGURE 18.

A further jointing member which may be used is that shown at 18 in FIGURE 19 and which has a generally U-shaped cross-sectional form providing a groove 19 into which the edges of two sheets to be joined may be placed side by side.

When the U section member 18 is employed in joining sheets of the material 1 by radio frequency dielectric heating, an electrode assembly of the form illustrated in FIGURES 20 and 21 may conveniently be employed and which comprises two pressure members 20 carrying electrodes 21 between which the member 18 may be held. FIGURE 22 shows a modification in which the straight electrodes 21 are replaced by curved electrodes 22. In one method of use of the assembly of FIGURES 20 and 22 the potentials of the electrodes may form a balanced system about earth potential. In another the lead foil 2 may be earthed by capacitive coupling and the radio fre-

quency generator output connected to the electrodes which are electrically strapped together. The illustrated electrode systems act as moulds providing a consistent shape to the member 18 with neat clearly defined edges.

When the two sheets to be joined are in different planes, as they are, for example, in the material shown in FIGURE 22, one of the said sheets is preformed along one edge by bending it through an angle of approximately 90° to a convenient depth, as shown in FIGURE 21.

This operation brings the two sheets in parallel relationship and they can then be inserted together in the groove of the U-shaped extruded member. In use of the member 18, fusion or welding is achieved between the sheets themselves and the member 18 as well.

The described joining methods using extruded jointing members provide the means of sealing off all exposed edges of the material and accordingly eliminates ingress of moisture through capillary action between the laminae. In order that a protective covering formed from material 1 according to this invention can easily be opened and resealed again, such covering preferably incorporates one or more moisture vapour-tight, water-tight, air-tight and light-tight slide fasteners.

The said fastener or fasteners may be of the form described and claimed in British Patent No. 723,998 or British Patent No. 731,144 or described in British patent application No. 20,258/56.

Alternatively, the fastener or fasteners may be of the form, such as is described in British patent specification No. 522,663, which comprises two extruded strips having interfitting parts. The said strips may also have grooves for receiving pieces or parts of material according to this invention so that the latter may be sealed to such extruded strips. Thus the said strips may have grooved parts so formed that, when the fastener is closed the said parts are equivalent to a jointing member of the form previously described.

In one convenient form, the two extruded strips may comprise strips such as the strips 23 and 24 shown in FIGURE 23, the strip 23 having a longitudinal tongue 25 enlarged at its free end and the strip 24 having a corresponding longitudinal groove 26 to receive the tongue. The two strips 23 and 24 are preferably heat welded at their ends which are covered with a metal cap or band holding them tightly together at one end and a slide 27, as shown in FIGURE 24, is engaged over the strips, such slide 27 having a tapered hole 28 through which the strips pass. The slide 27 is open at the lower face of the slide and is provided at its upper part within the hole 28 at the larger end thereof with a wedge 29 tapering in the same direction as the hole 28 so that, as the slide 27 is moved in one direction, the wedge 29 forces the two strips apart, whilst, as the slide is moved in the opposite direction, the tapering of the hole 28 causes the two strips to be pressed together.

The fastener illustrated in FIGURE 23 is particularly effective for use in a covering formed of material according to this invention. If the strips 23 and 24 are imagined to be joined so that the tongue 30 fits into the groove 31 and the hook-like part 32 fits into the recess 33, then a pull in the direction of the arrows A will cause the faces 34 and 35 to act as a fulcrum and the tongue 30 being fully engaged in groove 31 prevents the ball tongue 25 from moving upwards and the part 32 is locked in the recess 33.

Other useful forms of slide fastener are illustrated in FIGURES 25 to 30. Instead of being provided with integral co-operating tongue and groove means, these fasteners are provided with interlocking metal parts which, when interlocked, draw the two strips together and cause two portions of the latter to be pressed against one another tightly enough to form a seal. The metal parts may be of any form suitable and may be of any form known in slide fastener manufacture.

In the form illustrated in FIGURE 25, two extruded

strips 36 and 37 have embedded therein a spiral 38 (see FIGURE 26) the two spirals being of a form capable of interlocking with one another. In the form illustrated in FIGURES 27, 28 and 29, one strip 39 includes a flat spiral 40 and the other strip 41 includes a series of arrow-like members or vertebrae 42 adapted to interlock with the spiral 40. In a further alternative each strip may have a series of arrow-like members or vertebrae adapted to interlock with each other.

The metallic components may conveniently be positioned in the extruded strip by heating the metal and pressing it into the strip. Heating may conveniently be applied by induction, conduction or by the passage of an electric current or any other convenient method. Accurate register of the metallic component in relation to the extruded strip may conveniently be achieved by the use of jigs.

We claim:

1. A flexible protective covering sheet material comprising a layer of lead foil and a sheet of fabric reinforced flexible corrosion-resistant heat-sealable material having a thickness of not less than 0.01 inch adhered to each side of and impressed into the said foil.

2. A flexible protective covering sheet material comprising a layer of lead foil and a sheet of fabric reinforced plasticised polyvinyl chloride resin having a thickness of not less than 0.01 inch adhered to each side of and impressed into the said foil.

3. A flexible protective covering sheet material comprising two unstretched sheets of plasticised polyvinyl chloride resin having a thickness of not less than 0.01 inch and reinforced with woven cotton and lead foil sandwiched between and so adhered to said two sheets that the sheets are impressed into the lead foil.

4. A method of forming a flexible protective covering sheet material, such method comprising forming two

sheets of polyvinyl chloride resin having a thickness of the order of 0.015 inch; combining each of said sheets with a woven fabric as a reinforcement; applying an adhesive to the fabric side of the reinforced sheets; and simultaneously bringing the said two sheets and a layer of lead foil in superposed relation with the lead foil sandwiched between the sheets and hot calendering the assembly so formed.

5. A flexible protective covering sheet material consisting of an inner layer of lead foil having a thickness of the order of 0.003 inch; an outer sheet of cotton reinforced plasticised polyvinyl chloride resin having a thickness of the order of 0.015 inch covering each side of said lead foil layer and impressed into the said layer; and an intermediate film of an adhesive having a good preliminary tack.

6. A flexible protective covering sheet material as specified in claim 5 wherein the adhesive is a solution of the combination of phenol-formaldehyde and a synthetic rubber compound.

References Cited in the file of this patent

UNITED STATES PATENTS

622,889	Forsyth	Apr. 11, 1899
1,383,726	Kiracofe	July 5, 1921
1,611,031	Henderson	Dec. 14, 1926
2,053,773	Freydberg	Sept. 8, 1936
2,208,619	Armor	July 23, 1940
2,252,539	Adams	Aug. 12, 1941
2,355,559	Renner	Aug. 8, 1944
2,403,077	Hershberger	July 2, 1946
2,428,716	McGill	Oct. 7, 1947
2,584,722	London	Feb. 5, 1952
2,728,703	Kiernan et al.	Dec. 27, 1955
2,796,624	Speer	June 25, 1957
2,858,451	Silversher	Oct. 28, 1958