Feb. 6, 1962 M. A. ORLINS 3,019,753

METHOD OF FORMING INTERIOR-LINED SHEET METAL CONTAINERS

Filed April 24, 1953 2 Sheets-Sheet 1

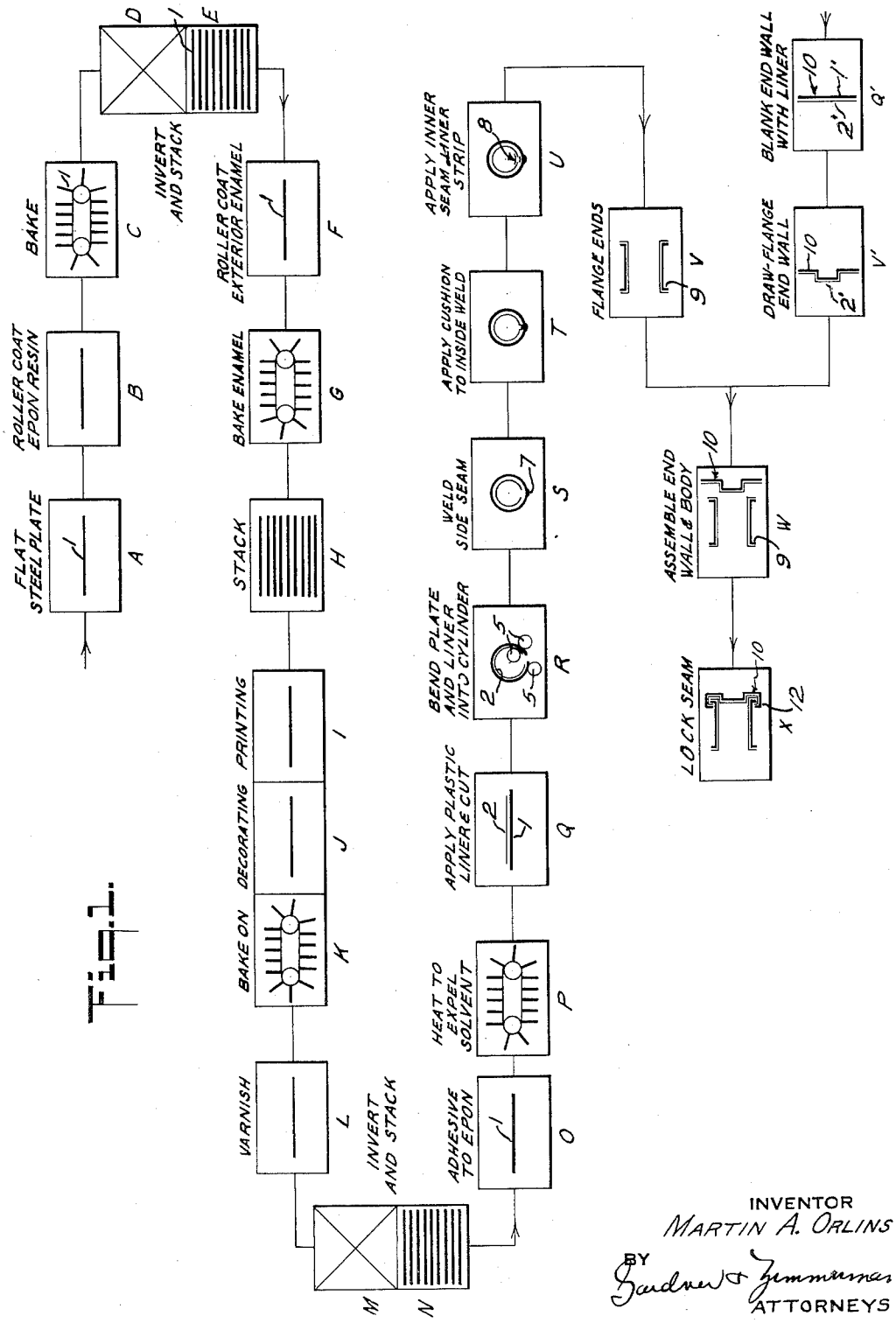


Fig. 1.

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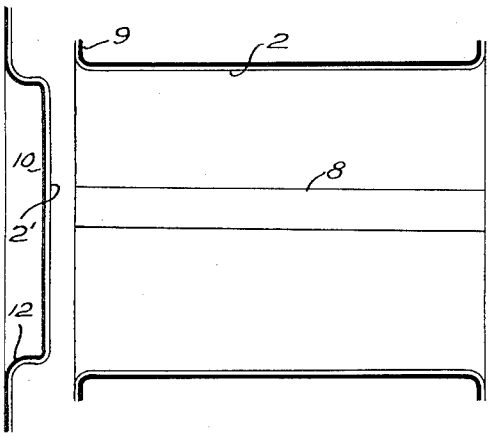


Fig. 2.

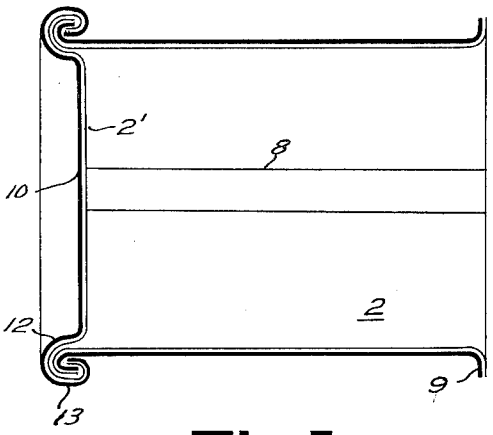


Fig. 3.

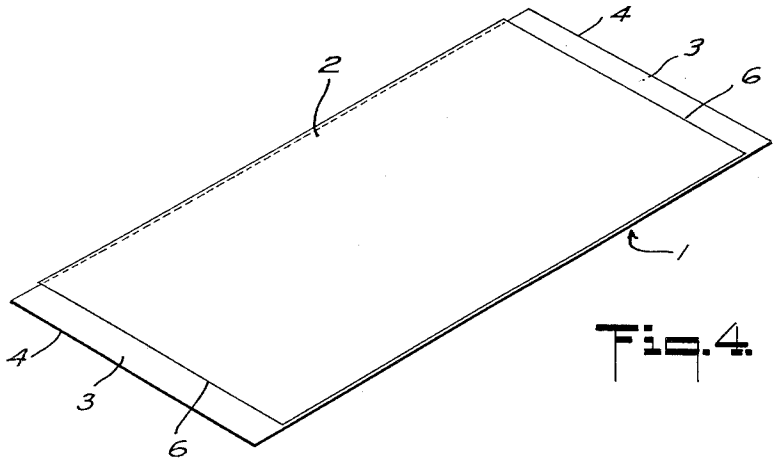


Fig. 4.

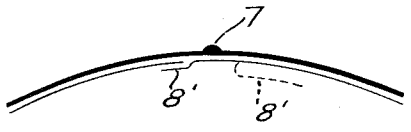


Fig. 5.

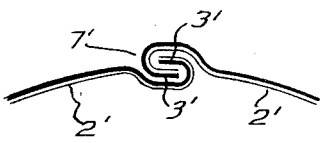


Fig. 6.

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3,019,753

METHOD OF FORMING INTERIOR-LINED SHEET METAL CONTAINERS

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10 Claims. (Cl. 113—120)

The invention relates to method of forming a metal container with a non-metallic internal liner, and is particularly adapted for fabricating sheet metal containers with a liner of plastic sheeting. By providing such a container the strength and durability of the metal is available and at the same time the container may be utilized for shipping or storing contents which should be kept free from contact with the metal. More especially the present invention is mainly concerned with containers ranging from large sized sheet metal drums of many gallons capacity down to smaller containers such as pails and cans.

An object of the invention is to provide a method of the character described in which the application of a sheeting to the inner surface of the metal side walls of the container or drum may be effectively accomplished without entailing the operation of applying and securing the entire sheeting to such surface as an operation or step performed after the container shell has been formed.

Another object of the invention is to provide a method of fabricating a sheet metal container with an interior lining, in which the sheeting designed to constitute the inner liner will be applied before the shell is formed.

A further object of the invention is to provide a method of the character described in which substantially all of the operations of applying the interior and exterior coatings or laminations for the container walls, including the sheeting for the inside surface of the walls, are performed after the plates or sheets which are to constitute the walls of the container, have been cut to size to form the walls, and while the plates are in flat form.

A still further object of the invention is to provide a method of the character described which lends itself to compact stacking and storage of the product at different stages in the process so that large scale operation may be carried on with minimum space requirements and the continuity of the successive phases of the process interrupted, or resumed after interruption, without interfering with efficiency in the output.

An additional object of the invention is to provide a method of fabricating a sheet metal container with an internal liner of sheeting material, in which the various deforming operations performed in the course of formation of the metal portion of the container is utilized as a means of stretching the sheeting over the metal surface so that the sheeting may be held against such surface without any wrinkles or ripples therein.

Yet another object of the invention is to provide a method of the character described which will provide first for the retention of an elastic plastic-sheeting on the metal as the internal liner therefor, and second, for application directly against the liner of the forces for effecting the deformation of the metal in the course of fabricating the container whereby the liner will be firmly held to the metal and caused to stretch during such deformation.

The invention possesses other objects and features of advantage, some of which with the foregoing will be set forth in the following description of the preferred form of the invention. It is to be understod, however, that variations in the form of the invention may be made or adopted without departing from the spirit of the invention as hereinafter claimed.

In the drawing accompanying the specification:

FIGURE 1 is a diagrammatic representation of the steps

of the process of my invention in the preferred embodiment.

FIGURE 2 is a diagrammatic showing of the body and end wall of a sheet metal drum in longitudinal section, the parts being shown in the form they present after certain of the deforming operations are completed.

FIGURE 3 is a view similar to FIGURE 2, but showing the parts in assembled and secured relation.

FIGURE 4 is a diagrammatic perspective view showing the metal sheet and liner in one of the preliminary forming operations.

FIGURE 5 is a diagrammatic representation of a modified means of joining the opposite edges of the aforesaid sheet and liner.

FIGURE 6 is a diagrammatic representation of a modified form of seam for the side edges of the sheet and liner.

The fabrication of sheet metal containers equipped with a lining in the form of a separate sheeting applied to inner surface of the metal walls of the container has heretofore been attempted by first completing the formation of the metal shell and thereafter inserting the sheeting into the interior of the shell and then applying same to the inside surface of the walls, the end walls of the container being attached to the shell either before or after the application of the sheeting to the shell. This method of lining the container entails the disadvantage of having to work with a bulky shell when applying the sheeting, carry considerable material and mechanism to the interior of the container, and perform a multiplicity of relatively difficult and awkward operations within the shell. Application of the liner in this manner is also unsatisfactory in that extreme difficulty is encountered in applying the liner in position on the walls so that the liner will be tight and free of ripples and remain so in the continued usage of the container.

In contrast to the foregoing, the process of the present invention requires but relatively few operations to be performed on the interior of the shell, practically all of the major operations of applying the liner sheeting being carried out while the sheets or plates of which the shell and other parts of the container are to be formed, are in a flat position. The few operations which the process of the present invention require to be performed within the interior are of a nature which may be easily effected, and in certain instances may largely, if not wholly, be dispensed with as will hereinafter appear. Furthermore, in accordance with the present invention, the deformation of the metal shells as required for the fabrication of the container, is arranged to be effected after instead of before the lining has been applied to the sheets, and advantage of this fact is taken to produce a tight and smooth fit of the liner over the entire area of the metal.

In performing the process of my invention in the preferred embodiment, the various steps are taken consecutively with the aid of mechanism to provide a production line. The process will be described in connection with the fabrication of a drum of sheet steel and an internal liner of plastic sheeting.

The process as it applies to the fabrication of the drum body will be explained first, and for the purpose of such description, the order and arrangement of the various steps of this phase of the process is indicated on the drawing by reference letters. The first step may be considered to be the production or provision of a flat steel plate 1 which is of a size and form to provide a shell of desired transverse and longitudinal dimension when the plate is subsequently bent or rolled into cylindrical form. This first step is indicated as A on the drawing. The plate which is usually rectangular in outline is arranged to be held in horizontal position and supported on its underside so as to leave the upper surface free and unobstructed. While the plate is so positioned, if desired, a hardy film,

such as of phenolic or epon resin may be applied in liquid form, as by roller coating, to said upper surface of plate. This latter step is indicated by the letter B. The coated plate is then passed into a furnace indicated at C, where the epon is subjected to a temperature such as 375° or 400° Fahrenheit so as to become thoroughly baked and hardened. The epon is desirable in order to provide a tough undercoating for the liner to be subsequently applied thereover and may in the meantime serve as a protective film for the one side of the plate prior to the application of the liner. After this operation, the plate is removed from the furnace and inverted and stacked as indicated at D and E, ready for further treatment when desired.

The next step in the process is the treatment of the side of the plate which will constitute the outer surface of the shell when the plate is ultimately bent into cylindrical form. Since this side is now on top, in order to initiate the treatment thereof, it is only necessary to withdraw the plate from the stack E and advance it in this position while supported from underneath. Desirably at this point, a relatively heavy coating of enamel is preferably roller coated over the top of the plate, and the enamel is then baked on at a temperature in the neighborhood of 400° Fahrenheit. After the baking operation is completed the plates may then be stacked as indicated at H in the drawing, and as will be evident, the plate when thus stacked, has a protective coating on both sides so that the storage of the plates at this time may be continued over an indefinite period without danger of corrosion.

In case the drum is to be lithographed or otherwise provided with indicia on the outer surface thereof, it is preferable to perform the printing and decorating operation at this stage since the appropriate surface of the plate is still flat and on top. Such operations, including the baking of the printed and decorative matter, are then performed in desired sequence as indicated by the letters I, J and K. A suitable protective varnish is usually then applied over the baked-lithographed surface, and after the varnish has dried, the plate is again inverted and stacked with the epon-coated surface up, the inverting and stacking operation being represented by the letters M and N in the drawing.

The plate is now ready for the steps involved in applying and securing of the liner to the plate. The liner which is to be applied is required, in the preferred embodiment of the invention, to be flexible and elastic and it has been determined that a plastic sheeting **2** such as "saran," "mylar," or the like, is ideally suited for the purpose. The advantage of using such a sheeting is that besides being suitable for direct contact with food or chemical products, it is extremely tough, possesses great tensile strength even when quite thin, and has excellent dimensional stability and chemical resistance at both high and low temperatures. In order to secure the liner to the plate, an adhesive is interposed between the liner and the epon, and in preferred form of the invention, the application of the adhesive comprises the next step in the process. Preferably the adhesive is applied in the form of a film directly upon the epon, the application being effected by roller coating the adhesive upon the exposed surface of the resin, such step being indicated by the letter O in the drawing. The adhesive can be applied first either to the plastic sheeting or to the plate, but the application first to the plate is specifically described herein. The adhesive utilized has a latex base with definite plastic characteristics such as the elasticity of the "saran" or "mylar." Such an adhesive will afford an excellent bond between the resin and liner. After the adhesive has been applied, it is subjected to a temperature sufficient to expel the volatile solvents from the adhesive but leave the latter in a tacky state. The removal of the solvents eliminates any danger of the creation of any blisters under the plastic sheeting when it is subsequently applied over the adhesive.

The next step is the actual application of the plastic

sheeting over the adhesive, and this step, which is indicated at Q, is performed while the plate and adhesive are still hot. Desirably the sheeting is of the same width as the plate, and is preferably fed from a roll directly upon the plate and in such manner that the longitudinal edges of the sheeting will register with the corresponding edges of the plate. The sheeting may be pressed against the adhesive coating by means of a resilient roller or the like, and is cut to a length and so positioned on the plate as to cover all of the surface thereof except for marginal portions **3** at what at this stage may be termed the ends **4** of the plate. This foreshortening of the liner is provided for, because in the subsequent fabrication of the shell, such marginal portions are to be welded together to form a side seam, and in order to provide for proper welding, the metal portions at the weld area, must be left clean and bare.

The flat plate as thus coated and equipped with the plastic sheeting, is now ready to be bent into cylindrical form so as to provide the shell of the drum. This step is indicated at R. The plate is to be bent of course with the plastic-sheeting on the inside, and the bending may be accomplished with the use of conventional apparatus. A type of such apparatus is diagrammatically illustrated at the designation R, and as will be noted such apparatus involves the use of pressure or thrust rollers **5** to be applied to both sides of the plate. It will thus be seen that in bending the plate to form, one of the forces will be applied directly against the plastic sheeting surface. It is thus of utmost importance that both the sheeting and adhesive, as well as the metal, be strong enough and possess sufficient dimensional stability to withstand concentrated compression forces of relatively great power.

After the shell is formed, the ends **4** of the metal sheet will be positioned adjacent each other and extend longitudinally along the sides of the shell. Likewise the ends or edges **6** of the plastic sheeting will be positioned in adjacent relation but will be appreciably spaced apart due to the intervening bare metal portions. The said ends or edges of the metal are then seamed together as at **7**, preferably as aforesaid, by welding for the full length of the shell. The step of performing the side seam weld is designated at S.

The next stage of the process is to cover the space on the interior of the drum between the aforesaid adjacent edges of the liner sheeting, including the weld area **7**. This part of the process preferably includes two operations. One is to coat the welded seam with a cushioning film such as a heavy water-emulsion lacquer so as to level out irregularities and cover any sharp edges, and the other is to cover, for the length of the shell, the adjacent side edges of the plastic sheeting and the space therebetween, including the lacquer, with a strip **8** of plastic material preferably the same as the sheeting. An adhesive is interposed between the lacquer and strip. In performing these operations, the lacquer is applied by roller coating over the weld longitudinally within the shell. The strip which is of a width sufficient to overlie both edge portions of the main lining is preferably provided with a pre-applied coating of adhesive on one side. In order to simplify the application of the strip, the stripping material is preferably wound on a roll which is moved longitudinally through the shell so that a proper length of the sheet may be unrolled and pressed, with the adhesive toward the lacquer, upon the aforesaid area to be covered. Thus the strip will be firmly secured to the shell and attached and sealed to both edge portions of the liner.

Instead of having the strip **8** in the form of a piece of material separate of the liner sheeting **2**, it may as shown in FIGURE 5, be formed as an integral extension **8'** of what would otherwise be one of the ends **6** of the sheeting. When in this form, the extension strip may be folded back or otherwise kept spaced from the side seam during the welding operation, and then after the lacquer coating has been applied to the weld, and a coat of adhesive ap-

plied over the area to be covered by the strip, the latter is moved to and firmly pressed in position over such area.

While in the preferred embodiment of the invention the edges 4 are seamed by welding, in certain instances it may be deemed preferable to join such edge portions in another manner, as for example by the lock-seam 7' diagrammatically illustrated in FIGURE 6. In using this type of seam, the liner sheeting 2' is preferably coterminous with the metal sheet at both ends so that a double thickness of the liner material will be interposed between the interlocked portions 3' of the metal sheet and thus provide an effective sealed joint.

With the shell now completely lined with the plastic sheeting, it is ready for the flanging operation indicated at V. This consists of bending either or both of the open ends of the shell outwardly to provide a flange 9 which is used in subsequently securing an end wall 10 such as the bottom and head to the shell. The operation of deforming the shell in an outward direction has a particular bearing on the present invention since such operation is performed at a time when the lining sheeting is already in place and secured on the shell walls. As will be evident, as the flanging operation is being effected, the metal nearer the outer side of the shell will be compressed while that nearer the inner side will be expanded. Therefore since the lining sheeting is elastic and is mounted on the side of the metal which is expanded, it will likewise expand in conformity with the metal. In this connection it is to be noted that the flanging operation requires the bending forces to be directed from the inner side of the shell and therefore the flanging tools have to be applied directly to the plastic liner. In this way, the tools will aid in holding the sheeting against the metal in the zone of bending during the deforming operation, thus easing the tension on the adhesive and permitting ample stretching of the lining upon the metal without any danger of separation of the lining at the edges or at the portion of the metal at which the expansion of the metal is taking place. It is to be noted that when the deformation of the metal has been completed, it will remain in its deformed shape permanently and under relatively little or no stress. On the other hand, the liner sheeting on thus being stretched and held in an extended position, remains in a state of stress, and as a result the sheeting will be drawn into and maintained in a smooth and taut condition over the metal practically indefinitely.

To a substantial extent, the fabrication of the end wall for the container is the same as the body or shell. The metal plate 1' which is to provide the end wall is blanked in conformity with the size and form of the body to which it is to be attached, the plastic sheeting 2' being applied either before or after the blanking operation, but while the sheet is flat. The sheet with the lining secured thereto is indicated at Q' in the drawing. Since the shell as heretofore described is of cylindrical form, the end wall will of course be in the form of a disk. With the end wall thus provided, the peripheral portions are drawn as indicated at V' to provide a flange 12 in substantially the same manner as the aforesaid flange on the shell, and this operation again draws the liner into tight and smooth position on the metal. The wall is then, as indicated at W, placed at the end of the body to which it is to be secured, and the final operation such as lock-seaming as shown at 13 the flanged portions of the end and side walls of the drum completed, this final step being indicated at X.

Various other operations in the fabrication of drums may be incorporated with or added to the operations herein described, but are not referred to as being well known.

I claim:

1. The method of forming a container shell with an expansible metal sheet and a separate liner of elastic plastic-sheeting exposed to the inside of the container after the formation thereof with opposed surfaces of

said sheet and sheeting in confronting adjacent relation, which comprises providing said metal sheet in a relatively flat form and of a size to be rolled into cylindrical form to provide said shell, applying an adhesive to one of said surfaces, covering said surface of said sheet with said sheeting, deforming said sheet into cylindrical form with the sheeting on the inside thereof, and stretching the sheet together with the lining generally parallel to the axis of said shell to permanently deform the sheet and place the sheeting in a state of tension whereby wrinkles formed in the sheeting during the deformation of the sheet into cylindrical form will be removed.

2. A method of forming a container shell of sheet metal which may be deformed by cold-drawing and is provided with an internal liner of plastic sheeting of relatively elastic material with a surface thereof exposed on the inside of the container and with the other surface of the sheeting in confronting adjacent relation to a surface of the shell, which comprises providing said metal sheet in substantially flat form of a size to provide one of the parts of the container, providing separately of said sheet said plastic sheeting, applying an adhesive to one of said confronting surfaces, covering and securing to one side of said sheet by means of said adhesive said plastic sheeting while the sheeting is in said flat form and without subjecting the sheeting to any substantial tensional stress, deforming said sheet into a cylindrical shell with the sheeting on the interior thereof and while the sheeting is thus secured to the sheet to thereby permanently deform said sheet without subjecting the sheeting to any substantial tensional stress, and then further deforming said sheet to stretch the sheeting over the sheet generally parallel to the axis of the shell and hold it permanently thereon in a state of tension whereby wrinkles formed in the sheeting during the formation of the sheet into a cylindrical shell will be removed.

3. The method of fabricating a container formed of sheet metal which may be deformed by cold-rolling or drawing and provided with an internal liner of relatively elastic plastic-sheeting with opposed surfaces of said container and liner in confronting adjacent relation, which comprises providing sheets of said metal in substantially flat form—one of substantially rectangular form to provide the side walls of the container and another of substantially circular form to provide an end wall of the container, applying an adhesive to one of said opposed surfaces, covering and securing to said surface of each of said sheets a liner of said plastic material with said adhesive interposed between the back sheet and the associated liner, bending the rectangular sheet into the form of a shell with the liner on the inside and by application of force simultaneously to the exposed sides of the sheet and liner, seaming the adjacent side edges of shell together, bending outwardly the marginal portions at an end of the shell by application of force against the liner to thereby permanently stretch the sheet in a direction generally parallel to the axis of the shell and set up a tension in the sheeting tending to relieve any wrinkles formed in the sheeting during the bending of the sheet into said shell and keep the same taut and resiliently pressed against the sheet, deforming the marginal portions of the circular sheet by application of a force against the sheeting so as to set the metal in a stretched condition and the sheeting in a state of tension tending to keep the same taut and resiliently pressed against the sheet, and then securing together the marginal portions of the side walls to the marginal portions of the end wall with further deformation of said sheets and further stretching of each of said liners with the liners compressed therebetween.

4. The method of forming a metal container shell with an interiorly exposed independent lining of pliant plastic sheeting with opposed surfaces of said shell and sheeting in confronting adjacent relation, which comprises providing a metal sheet in flat form and of a size to provide

the side walls of the container, applying an adhesive to one of said surfaces, positioning upon one side of the sheet while the sheet is in flat form a separate substantially full covering of plastic sheeting while leaving the ends of the sheet uncovered, pressing the sheet and sheeting together with said adhesive therebetween, bending the sheet and sheeting in cylindrical form with the sheeting on the inside without imparting any substantial tensional stresses to the sheeting, securing the adjoining opposing uncovered edges of the sheet together and likewise connecting the corresponding edges of the sheeting together so as to provide a sealed joint therebetween, and then forming an outwardly directed flange on an end of said cylindrical sheet and causing said sheeting to be stretched with the sheet in a direction generally parallel to the shell axis and maintained in a state of tension against the inner surface of said sheet thereby removing any undesirable wrinkles imparted to said sheeting during the bending of the sheet and sheeting into cylindrical form.

5. The method of forming a sheet metal container with an interior independent lining of plastic sheeting with opposed surfaces of said shell and sheeting in confronting adjacent relation, which comprises providing a metal sheet in flat form to provide the cylindrical side walls of the container, applying an adhesive to one of said surfaces, positioning said plastic sheeting upon the metal sheet while the latter is in flat form with said adhesive therebetween and with two opposed edges of the sheeting disposed inwardly of the corresponding edges of the metal sheet and with the other two edges being substantially coterminous with their corresponding metal sheet edges, bending the sheet and sheeting into cylindrical form with the sheeting on the inside and so as to bring the uncovered edges of the sheet in intimate relation but leave the first mentioned opposed edges of the sheeting in spaced relation, welding the uncovered edges of the sheet together, and thereafter covering the weld area space between the edges of the sheeting with a plastic sheet strip and securing the same to the metal sheet, and then stretching the cylindrical shell in a direction parallel to the axis thereof to permanently deform the shell and place said sheeting in a state of tension whereby wrinkles formed therein during bending of the sheet into cylindrical form will be removed.

6. The method of forming a metal container with a baked-on finish on its exterior surface and a lining of plastic sheeting on its interior surface, which comprises providing a flat metal sheet to form the side walls of the container, applying a phenolic coating to and baking same upon one side of the plate, thereafter baking a coating of enamel on the reverse side of the sheet, thereafter applying over the phenolic coating a thermo-setting adhesive, applying a plastic sheeting over the adhesive while the temperature of the metal sheet is approximately between 190 and 210 degrees Fahrenheit, then bending the sheet to cylindrical form with the plastic lining on the inside, then joining the side edges of the sheet together, and then coating the joined edges on the interior of the container with a cushioning film of lacquer, covering the side edge portions of the sheeting and the space therebetween with a layer of adhesive, and then applying over such layer a strip of plastic sheeting.

7. The method of forming a metal drum with a plastic interior lining, which comprises providing a flat metal plate of a size to form the side walls of the drum, applying an undercoating to one side of the plate, applying a film of enamel to the reverse side of the plate and baking same thereon, applying over the undercoating a coating of a latex-base adhesive, applying heat to the adhesive to remove any volatile solvents therein, applying a plastic sheeting over the adhesive at a temperature of approximately between 190 to 210 degrees Fahrenheit, the said coatings and the sheeting having been omitted from the side edge portions of the plate which are to subsequently provide a side seam for the drum, then bending the plate into cylindrical form with the sheeting on the inside and so as to bring the side edges of said plate on which said sheeting has been omitted into relation for welding, welding said plate edges to provide a sealed joint, then covering the welded joint on the interior of the drum with a layer of cushioning material, covering the side edge portions of the sheeting and the space therebetween with a film of adhesive, and then applying over such adhesive film a strip of plastic sheeting.

8. The method of forming a metal drum with a plastic interior lining and a baked-on enamel exterior coating which comprises providing a flat metal plate of a size to form the sides of the drum and supporting the plate on its underside in horizontal position, applying to the upper surface of the plate except at the side edge portions which are to subsequently be brought together and form a side seam for the drum a protective film covering, inverting the plate to position the covered metal surface on the bottom, applying a coating of enamel to the upper surface of the sheet and baking same thereon, thereafter lithographing and finish-coating the enameled surface, again inverting the plate to position the protective film-coated surface on top, covering said film-coated portion of the plate surface with a thermo-setting latex-base adhesive coating while in heated state, maintaining a heated condition at the adhesive coating sufficient to liberate the volatile solvents therefrom but less than that at which the enamel was baked on the plate, applying substantially exclusively only to the adhesive coating a lining of plastic sheeting while the adhesive is maintained in a heated and tacky state, then bending the plate into a cylinder with the lining on the inside and with the side edges of the plate in position for welding them together and with the corresponding edges of the lining spaced from the plate edges and from each other, welding each plate edges together, covering the weld with a layer of cushioning material on the inside of the drum, applying an adhesive coating over said edge portions of the plastic lining and the space therebetween, and then applying over said last mentioned coating a strip of plastic sheeting substantially the same as said first plastic sheeting.

9. The method of forming a sheet metal shell of a container with a liner of plastic sheeting on the interior with opposed surfaces of said shell and sheeting in confronting adjacent relation which comprises providing a rectangular metal sheet in flat form and of a size to provide the side walls of the container, applying an adhesive to one of said surfaces, rolling upon a side of the plate from one side edge to the other and with said adhesive therebetween a layer of plastic sheeting which is foreshortened so as to leave bare the portions of said side of the metal sheet along said opposed edges, bending the sheet into cylindrical form with the bared side edges in position for welding and with the lining on the inside and the edges of the lining in spaced relation, welding said bared metal edges together to provide a sealed joint, rolling longitudinally through the container and securing upon the aforesaid edge portions of the plastic sheeting and the space therebetween a strip of plastic sheeting to thereby provide a sealed interior lining of plastic completely around the side walls of the container, and then stretching the cylindrical shell in a direction parallel to the axis thereof to permanently deform the shell and place said sheeting in a state of tension whereby wrinkles formed therein during bending of the sheet into cylindrical form will be removed.

10. The method of forming a sheet metal drum with an interior plastic lining, which comprises providing a flat sheet metal plate of a size to form the side walls of the drum, supporting the flat plate so that one side is unobstructed covering substantially said entire side of the plate with an undercoating of thermo-setting material and baking same upon the plate, inverting the plate so that the reverse side will be unobstructed, covering substan-

tially said entire reverse side of the plate with an enamel and baking same thereon, inverting the plate to present the first side without obstruction, applying a latex-base adhesive coating over the entire thermo-setting undercoating, heating the adhesive coating to expel any volatile solvents, thereafter applying to the adhesive coating while in heated tacky condition a lining of plastic sheeting, bending the plate into cylindrical form with the lining on the inside welding the adjacent edges of the plate together, covering the weld on the inside of the drum with an undercoating of sufficient thickness to substantially level out any irregularities on the surface of the welded area, and applying over the adjacent edge portions of said lining and the area therebetween including said undercoating a strip of plastic sheeting with an adhesive coating against said coating and from which any volatile solvents have been expelled prior to the application of the strip.

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