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CONTAINER, CONTAINER STOCK, AND METHOD OF MAKING THE SAME

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Fig.1.

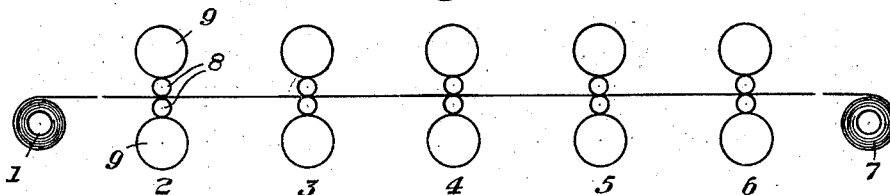


Fig.2.

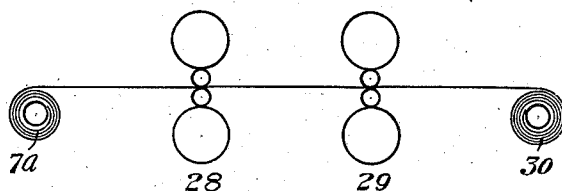


Fig.3.

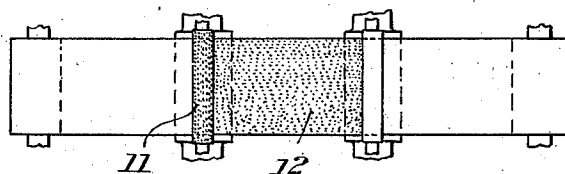


Fig.4.

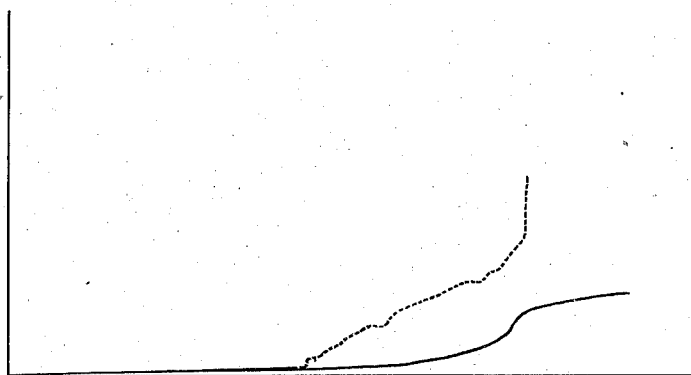
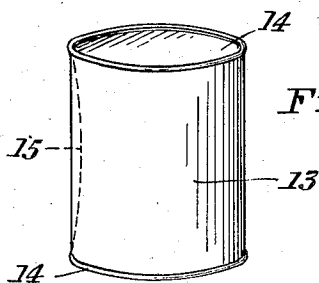


Fig.5.



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UNITED STATES PATENT OFFICE

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CONTAINER, CONTAINER STOCK, AND
METHOD OF MAKING THE SAMEJohn W. Erb, Martins Ferry, Ohio, assignor to
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15 Claims. (Cl. 29—18)

This invention relates to improved containers, container stock and method of making the same. It is of particular value in the manufacture of containers made of "tin plate" such as are used for packaging food products, but is also of value in containers made of "black plate", that is, of untinned sheet steel. Containers made of black plate are widely used either with a paper label or after lithographing. The invention provides a container stock having improved properties which make containers formed therefrom particularly resistant to "buckling" or "panelling". The material is also free of any marked tendency to "flute" during the forming of the can body. Can body stock is said to "flute" if instead of bending smoothly and continuously in the forming machine it takes a large number of well-defined bends so that the container is more polygonal than cylindrical in cross section. The difficulties of buckling and panelling arise in the use of the finished container. This can well be illustrated by describing what may happen in the cooking of vegetables sealed in a container in accordance with common canning practice. During such cooking the heat is supplied by steam under pressure which is fed into the chamber which holds the filled containers. The cooking will generally develop inside of the containers a pressure which is in excess of the pressure of the surrounding steam. In consequence the ends of the container bulge and if, after removal of the container from the cooking vessel and subsequent cooling, the ends stay bulged instead of returning to their normal shape, the container is said to be "buckled". It sometimes happens that upon cooling of the container after cooking the cylindrical side collapses inwardly to a greater or less extent, and this is known as "panelling". The difficulties of buckling and panelling are acute in certain classes of work as, for example, beer cans and in spinach and other vegetables whose packaging involves the use of relatively high temperatures or pressures.

It is well recognized that so-called Bessemer plate produced by pack rolling is quite resistant to deformities of the types above indicated, and for this reason Bessemer plate has continued to find uses despite the high cost of manufacture by pack rolling. It is now well recognized that the most economical way of producing tin plate or other container stock of comparable thickness is by the cold strip process wherein the metal is cold reduced under tension to materially less than half its original thickness without intermediate annealing. Sheet metal as ordinarily

produced by such process is more ductile than Bessemer plate but is less resistant to buckling, panelling and fluting.

It has been proposed to overcome the difficulty by temper rolling or skin passing the product, but this has not proven sufficient to meet the requirements of the trade. Various tests have been resorted to for determining the resistance of container stock to buckling and panelling. Undoubtedly the best test is that resorted to by certain can manufacturers who make up a series of cans of a standard size and subject them to standard test conditions which simulate the conditions encountered in service but which involve higher pressures. Unfortunately tests of this sort take a great deal of time and specialized equipment and are not satisfactory for mill purposes. I find, however, that a satisfactory measure of the properties of container stock to withstand buckling and panelling under present-day canning conditions may be obtained by subjecting the stock to the known "Schopper" test. So far as I am aware cold reduced container stock as heretofore manufactured has always had a Schopper yield value, for material of thickness .01", of well under 28 kilograms per square millimeter. Material having such Schopper values is not sufficiently resistant to buckling and panelling.

I obtain the desired improvement in physical properties of cold reduced steel by terminating the reduction short of the desired final thickness, preferably when the metal has a thickness of 3 to 5 percent in excess of the desired final gauge. I then locally work and roughen one and preferably both surfaces of the metal and then finally smooth the metal and reduce it to the desired final thickness. The local working of the surface is accomplished by subjecting the metal to the action of a roughened roll or rolls, preferably a sand blasted iron roll, which imparts to the previously smooth and mirror-like surface of the material a dull mat finish. I prefer that the elongation in this step and in the subsequent smoothing step shall not exceed in the aggregate 5 percent and preferably shall run about 3 percent. I also prefer that in the roughening step alone there shall be little or no elongation, say not to exceed more than 1 percent.

It is old and well known to roughen or dull the surface of sheet steel, being shown for example in McCarty Patent 10,047, dated September 27, 1853. The practice has often been resorted to if it is desired to make a metal having a suitable surface for the reception of paint or paint-like

coatings. See, for example, McColloch Patent 2,024,007. It has also been proposed to use roughened rolls where excessive reductions are to be taken and it is desired to avoid roll slippage.

5 See, for example, Adams Patent 1,932,168. However, so far as I am aware, it has not been realized that in the manufacture of container stock a suitably controlled roughening step followed by a suitably controlled smoothing step will serve to
10 improve vastly the qualities of the material for this particular purpose.

In the accompanying drawing illustrating a present preferred embodiment of the invention,

15 Figure 1 is a diagrammatic view illustrating the cold reduction of a strip of steel to approximately the desired gauge;

Figure 2 is a similar view showing the special treatment to improve the properties of the material;

20 Figure 3 is a top plan view of Figure 2 with the upper backing rolls removed;

Figure 4 is a Schopper diagram of my improved material; and

25 Figure 5 is a perspective view of a container made from such material.

Figure 1 shows the cold reducing mill wherein a hot rolled strip is fed from a coil 1 through a series of reducing stands 2, 3, 4, 5, 6 to a reel 7. Each of the stands 2, 3, 4, 5, 6 consists of
30 driven work rolls 8 having backing rolls 9. The material is cold rolled under tension and will generally be reduced to materially less than half its original thickness. While such material is satisfactory for most containers, it is less resistant
35 to fluting, buckling and panelling than Bessemer plate of the same thickness, although more ductile than Bessemer plate. The resistance of the material to buckling, panelling and fluting is enhanced by the treatment indicated in Figures
40 2 and 3, wherein the strip as formed on the mill of Figure 1 is fed from a coil 7a through mill stands 28 and 29 to a coiler 30. The stands 28 and 29 are both of the 4-high type having driven work rolls and being provided with backing rolls.
45 The work rolls of the stand 28 are roughened, as indicated at 11 in Figure 3. The roughening is preferably accomplished by sand blasting. I have experimented with other ways of roughening, for example, shot blasting, knurling, and etching, but
50 prefer to use a sand blast as it produces a roll which works the surface of the metal strip adequately and retains its roughness for a considerable period of time. I also prefer to use iron rolls rather than steel rolls for this duty. The
55 sand blast seems to cut more deeply into iron rolls than steel rolls. They will work the surface of the strip more drastically than steel rolls if this is desired and they have a longer life between dressings.

60 As the material issues from between the rolls 11, it has a mat surface as indicated at 12 in Figure 3. This mat surface is removed by the smooth work rolls of the stand 29, the issuing material having a bright surface. It will be understood that various degrees of reduction may
65 be effected in the stands 28 and 29 and particularly dependent upon the setting of the rolls in the stand 29 the surface appearance of the finished material may vary somewhat. I prefer
70 to roll with the material under tension in the stands 28 and 29 but to effect only a relatively small reduction in these stands. As the invention is now being practiced there is no elongation in the stand 28. There is an apparent thickening of the material due, of course, to the

roughening of the surface, so that as it passes through the stand 28 its thickness as determined by micrometers will be greater than on the entering side. I prefer that the aggregate elongation in the stands 28 and 29 shall be approximately 3
5 percent and shall not exceed 5 percent, and that the elongation in the stand 28 shall preferably be nil, and shall not exceed 1 percent.

Figure 4 shows a Schopper test curve which is typical of the material made in accordance with
10 the best practice of my invention. The curves will naturally vary under different conditions of use of the invention, but generally speaking will be characterized by a slow rise to the ultimate value with relative freedom from sharp upward
15 breaks as indicated by the dotted line of Figure 4 and as more or less characteristic of ordinary cold reduced material.

Figure 5 illustrates a container made from my improved material having a body 13 and heads
20 14. In the formation of the body 13 my improved material shows little or no tendency to flute as the finished container is quite resistant to panelling of the sort indicated by the dotted line 15. The heads are correspondingly free of
25 the tendency to buckle.

When I refer to "container stock" I intend to refer to simple steel having carbon not exceeding .20 percent and from 26 gauge .018 inch to 34 gauge .007 inch in thickness. The Schopper
30 value of my improved material will of course vary depending upon the thickness of the test piece, in a thickness of .01 inch it should have a value of at least 28.

After the material has been rolled it may be
35 cut up into sheets and tinned. I have found that it requires very little tin for coating and that the coating is quite satisfactory from the standpoint of continuity and freedom from pin holes or other localized foci of corrosion. One of the most in-
40 teresting and important features of my invention is the fact that it apparently minimizes age hardening. The step of tinning container stock generally makes the material more susceptible to age hardening, but my improved material retains
45 its qualities to a satisfactory degree despite the tinning step.

I have illustrated and described a present preferred embodiment of the invention but it will be understood that this is by way of illustration only
50 and that the invention may be otherwise embodied or practiced within the scope of the following claims:

I claim:

1. In the method of making thin sheet metal
55 stock resistant to buckling and panelling when formed into containers, the steps consisting in subjecting low carbon steel to cold rolling under tension and thereby cold reducing the metal to less than half its original thickness, terminating
60 the reduction when the metal has a thickness not exceeding 5 percent more than the desired final thickness, then locally working at least one surface of the metal by subjecting it to the action of a roughened roll, limiting the elongation in
65 such step to not more than 1 percent and then passing the metal between smooth rolls and therein reducing it to the desired final thickness and eliminating the surface roughness imparted in the preceding rolling step.

2. In the method of making thin sheet metal
70 stock resistant to buckling and panelling when formed into containers, the steps consisting in subjecting low carbon steel to cold rolling under tension and thereby cold reducing the metal to 75

less than half its original thickness, terminating the reduction when the metal has a thickness about 3 percent more than the desired final thickness, then locally working at least one surface of the metal by subjecting it to the action of a roughened roll, limiting the elongation in such step to not more than 1 percent, and then passing the metal between smooth rolls and therein reducing it to the desired final thickness and eliminating the surface roughness imparted in the preceding rolling step.

3. In the method of making thin sheet metal stock resistant to buckling and panelling when formed into containers, the steps consisting in subjecting low carbon steel to cold rolling under tension and thereby cold reducing the metal to less than half its original thickness, terminating the reduction when the metal has a thickness not exceeding 5 percent more than the desired final thickness, then locally working the surfaces of the metal by passing it between roughened rolls, limiting the elongation in such step to not more than 1 percent, and then passing the metal between smooth rolls and therein reducing it to the desired final thickness and eliminating the surface roughness imparted in the preceding rolling step.

4. In the method of making thin sheet metal stock resistant to buckling and panelling when formed into containers, the steps consisting in subjecting low carbon steel to cold rolling under tension and thereby cold reducing the metal to less than half its original thickness, terminating the reduction when the metal has a thickness about 3 percent more than the desired final thickness, then locally working the surfaces of the metal by passing it between roughened rolls, limiting the elongation in such step to not more than 1 percent, and then passing the metal between smooth rolls and therein reducing it to the desired final thickness and eliminating the surface roughness imparted in the preceding rolling step.

5. In the method of making thin sheet metal stock resistant to buckling and panelling when formed into containers, the steps consisting in subjecting low carbon steel to cold rolling under tension and thereby cold reducing the metal to less than half its original thickness, terminating the reduction when the metal has a thickness not exceeding 5 percent more than the desired final thickness, then locally working the surfaces of the metal by subjecting it to the action of roughened rolls, limiting the amount of deformation effected by such rolls so that there is substantially no elongation of the metal as it is rolled therebetween, and then passing the metal between smooth rolls and therein reducing it and eliminating the surface roughness imparted in the preceding rolling step.

6. In the method of making thin sheet metal stock resistant to buckling and panelling when formed into containers, the steps consisting in subjecting low carbon steel to cold rolling under tension and thereby cold reducing the metal to less than half its original thickness, terminating the reduction when the metal has a thickness about 3 percent more than the desired final thickness, then locally working the surfaces of the metal by subjecting it to the action of roughened rolls, limiting the amount of deformation effected by such rolls so that there is substantially no elongation of the metal as it is rolled therebetween, and then passing the metal between smooth rolls and therein reducing it and elimi-

nating the surface roughness imparted in the preceding rolling step.

7. In the method of making thin sheet metal stock resistant to buckling and panelling when formed into containers, the steps consisting in subjecting low carbon steel to cold rolling under tension and thereby cold reducing the metal to less than half its original thickness, terminating the reduction before the metal reaches the desired final thickness, then locally working the surfaces of the metal by roughening it between rolls having roughened surfaces, and then passing the metal between smooth rolls and eliminating the surface roughness imparted in the preceding rolling step, the elongation in the roughening and smoothing steps not exceeding 5 percent in the aggregate.

8. In the method of making thin sheet metal stock resistant to buckling and panelling when formed into containers, the steps consisting in subjecting low carbon steel to cold rolling under tension and thereby cold reducing the metal to less than half its original thickness, terminating the reduction before the metal has reached the desired final thickness, then locally working the surfaces by subjecting the metal to the action of sand blasted rolls, and then passing the metal between smooth rolls and therein eliminating the surface roughness imparted in the preceding rolling step, the elongation in the roughening and smoothing steps not exceeding 5 percent in the aggregate.

9. In the method of making thin sheet metal stock resistant to buckling and panelling when formed into containers, the steps consisting in subjecting low carbon steel to cold rolling under tension and thereby cold reducing the metal to less than half its original thickness, terminating the reduction before the metal has reached the desired final thickness, then locally working the surfaces by subjecting the metal to the action of sand blasted iron rolls, and then passing the metal between smooth rolls and therein eliminating the surface roughness imparted in the preceding rolling step, the elongation in the roughening and smoothing steps not exceeding 5 percent in the aggregate.

10. In the method of making thin sheet metal stock resistant to buckling and panelling when formed into containers, the steps consisting in subjecting low carbon steel to cold rolling under tension and thereby cold reducing the metal to less than half its original thickness, terminating the reduction before the metal has reached the desired final thickness, locally working the surfaces of the metal by subjecting it to the action of roughened rolls, then passing the metal between smooth rolls and therein eliminating the surface roughness imparted in the preceding roughening step, the elongation in the roughening and smoothing steps not exceeding 5 percent in the aggregate, and then tinning the smooth metal.

11. As a new article of manufacture, container stock consisting of steel in sheet-like form not exceeding 26 gauge in thickness and having a carbon content not exceeding .20, the body of the sheet having a ductility such as is obtained by cold reducing the metal under tension, the surface portions of the sheet having a temper of the character obtainable by rolling the sheet first through roughened rolls and then through smooth rolls with a maximum aggregate reduction not exceeding 5 percent in the roughened rolls and the subsequent smooth rolls, the sheet having a

Schopper value of at least 28 kilograms per square millimeter in a thickness of .01 inch.

12. The herein described container stock resistant to panelling and buckling when formed into containers obtained by subjecting low carbon steel to cold rolling under tension and thereby cold reducing the metal to less than half its original thickness, terminating the reduction before the metal has reached its desired final thickness, then locally working the surfaces of the metal by subjecting it to the action of roughening rolls, and then passing the metal between smooth rolls and eliminating the surface roughness imparted in the preceding rolling step, the aggregate elongation in the roughening and smoothing steps not exceeding 5 percent.

13. The herein described container stock resistant to panelling and buckling when formed into containers obtained by subjecting low carbon steel to cold rolling under tension and thereby cold reducing the metal to less than half its original thickness, terminating the reduction before the metal has reached its desired final thickness, then locally working the surfaces of the metal by subjecting it to the action of roughening rolls, then passing the metal between smooth rolls and eliminating the surface roughness imparted

in the preceding rolling step, the aggregate elongation in the roughening and smoothing steps not exceeding 5 percent, and tinning the smoothed metal.

14. As a new article of manufacture, a container made of cold reduced sheet steel having a body portion which possesses the ductility characteristic of steel which has been cold reduced under tension and having a surface temperature of the character obtainable by rolling the metal between roughened rolls and subsequent smooth rolls, the metal having a Schopper value of at least 28 kilograms per square millimeter in a thickness of .01 inch, the body portion being resistant to panelling.

15. As a new article of manufacture, a container made of cold reduced sheet steel having a head portion which possesses the ductility characteristic of steel which has been cold reduced under tension and having a surface temperature of the character obtainable by rolling the metal between roughened rolls and subsequent smooth rolls, the metal having a Schopper value of at least 28 kilograms per square millimeter in a thickness of .01 inch, the head being resistant to buckling.

JOHN W. ERB.