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METHOD OF HEAT TREATING EDGES

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FIG. 1.

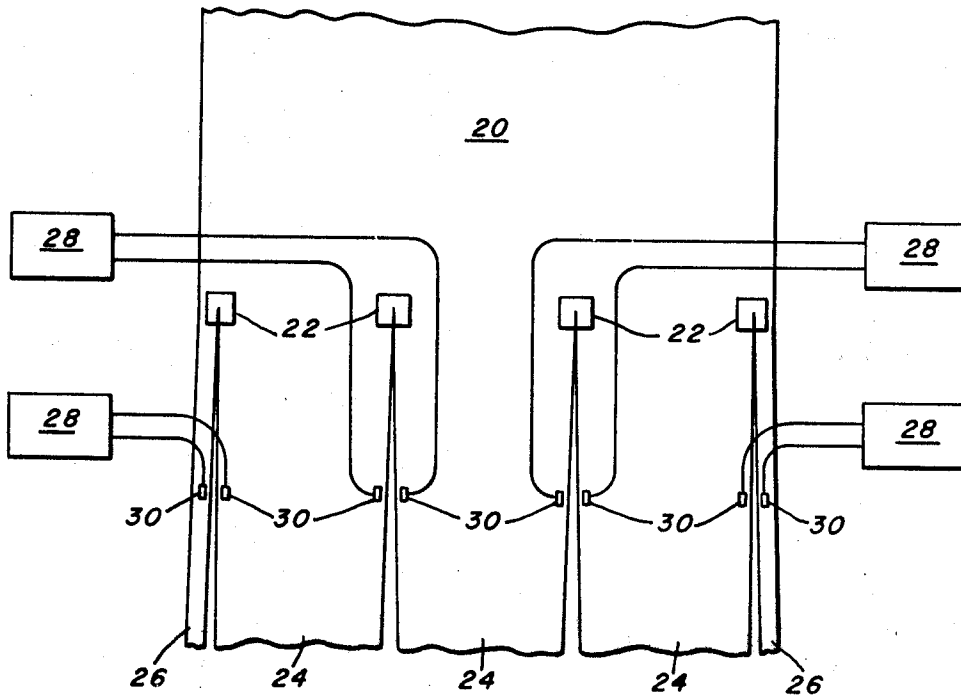
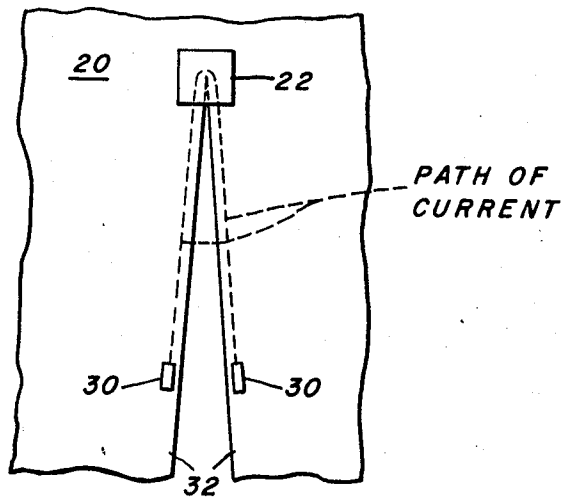


FIG. 2.



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METHOD OF HEAT TREATING EDGES

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ABSTRACT OF THE DISCLOSURE

A method of applying a heat treatment to the edge section of metal articles (e.g. plate, strip or sheet), in such a manner as to limit the effect to the edge. Products such as steel strip for can manufacture can be effectively annealed at the edges to soften same without affecting the properties of the remainder of the strip. The limited treatment is accomplished by controlled high frequency resistance heating applied during slitting of product into narrow widths.

For some applications, steel sheet or strip with heat treated edges only are desirable. Accordingly, there is a need for a method of processing such material so as to accomplish a desired heat treatment only at the edges of the material without affecting structural properties of the remaining portion thereof.

In one such application, steel furnished for use in manufacturing metal containers desirably should possess softer edges suitable for forming the flanges of container bodies. This is because the usual material furnished for can structures is double-reduced, tin-coated steel which is very hard and not suited for extensive forming operations. In such cases, it would be helpful if only the edge to be flanged were annealed to soften the material without reducing the desirable properties of the remainder of the strip for the container body. The present invention provides a successful and practical method of heat treating the edges only of metal strip so as to accomplish a desirable metallurgical transformation at that portion without reducing or altering the physical properties of the remainder of the metal strip. In the practice of the invention, the heat treatment is accomplished at the time the metal strip is slit to provide a straight-finished edge. In accordance with the invention, there is provided an improvement in the method whereby strips of metal are slit into bands by a slitter which makes at least one cut through a metal strip or sheet, which comprises applying current leads of a high frequency power supply to the slit strip at points adjacent to opposite edges of the strip as it emerges from a slitter. Sufficient power is supplied to heat the slit edges of the strip between the leads without so heating the remainder of the strip. The edge heating is affected by passages of current along the slit edges of the strip across the unslit vertex. This method of high frequency resistance heating can be used effectively where it is desired to limit the area to which heat is applied as described above to the edges only of a metal sheet or strip.

Other methods of heating the edges of metal strips have been proposed. These typically involve induction heating as by the use of coils, etc. energized by power generators. One problem with this approach is the difficulty of limiting the heat treatment to the edge because the heat tends to travel too far into the body of the strip. The present invention minimizes this problem by using high frequency resistance heating while the sheet or strip is being slit into narrow widths required for any given application such as can making. The high frequency resistance heating is limited to the edge of the strip because of the tendency

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of the high frequency currents in the two slit pieces to attract each other.

In the embodiment of the invention in which it is used to accomplish annealing of the edges of steel for containers which has been cold reduced, annealed, and then cold reduced a second time in the range of 25 to 50%, the power supply is adjusted so as to heat the edge to annealing temperatures. In this case, the product is often too hard (70 to 83 Rockwell 30-T) to readily form the flange on a can body although this hardness in the can body proper is beneficial to provide strength and stiffness. It is thus desirable to anneal only the edges of the strip to be used in making the can body. This strip is normally made by slitting a wide coil into several narrow coils of the proper width and, at the same time, edge trimming the wide coil. With the application of high frequency resistance heating in the range of 200 kHz. to 2,000 kHz. for steel in the thickness range of 0.001 to 0.007 inch, it is possible to heat the edge to a controlled depth which is normally adjustable over the range of 0.005 to 0.250 inch from the edges to temperatures in the range of 950 to 1350° F. These temperatures are normally used for annealing and thus reduce the hardness of the edge within the affected zone to a value less than 60 Rockwell 30-T.

The control offered by the high frequency resistance heating is such as to provide temperature control so effective that the temperature beyond ¼ inch from the edge can be kept below annealing temperatures, i.e. below 950° F., while the edge is heated to the aforementioned temperature range, i.e. 950 to 1350° F.

The following example in conjunction with the description of the attached drawing will serve to illustrate the invention. In the drawing:

FIG. 1 is a schematic plan view illustrating the method of the invention applied to heat treating the slit edges of metal strip as it emerges from a slitting machine; and

FIG. 2 is a schematic view of a single slit edge illustrating the path of current which effects the edge heating to heat treating temperatures.

Referring to FIG. 1, there is seen a strip 20 which may be of any desired width passing through slitter knives 22 which slit the strip into any desired number of narrow bands 24. In the illustration, three bands are slit including the trim-off of outer edges 26 which must be done to provide even ends. A high frequency power unit 28 provides electric current to the strip through contacts 30. The high frequency power source supplies power at a frequency of at least 10,000 cycles per second. In the preferred embodiment, the power source of 50,000 to 1,000,000 cycles per second is used. Frequencies in the lower portion of the range tend to yield wider heating bands. Thus, in order to limit the heating to the edge only, high frequencies as described must be used.

In the illustration shown in FIG. 2, a slitter knife 22 is positioned at the vertex of the slit. Current from a suitable power supply source, not shown, passes between rolling contacts 30 along the path of the dotted line on opposing edges 32 of the slit strip across the vertex.

It is apparent from the above that various changes and modifications may be made without departing from the invention. Accordingly, the scope of the invention should be limited only by the appended claims.

I claim:

1. In the method of longitudinally slitting and heat treating relatively wide moving metal strip wherein said strip is fed to a slitter which continuously makes at least one cut therethrough, the improvement whereby only the slit edges of the slit strip immediately adjacent the slitter are continuously heat treated to anneal and soften the same without affecting the properties of the remainder of the strip which comprises applying current leads of a high frequency power supply to the moving slit strip at

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points adjacent to opposing slit edges of the strip as it emerges from the slitter, providing power thereto to heat the slit edges of said strip between said current leads and the slitter to heat treating temperature without so heating the remainder thereof, said edge heating being affected by the resistance to passage of current along the slit edges of said strip and across the unslit vertex.

2. An improvement according to claim 1 wherein the strip is steel and the edges are heated to annealing temperature of 950 to 1350° F. to reduce the hardness of the edges to less than about 60 Rockwell 30-T.

3. An improvement according to claim 2 wherein said steel strip has a thickness in the range of about 0.001 to 0.007 inch.

4. An improvement according to claim 3 wherein the

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current leads are provided by rolling contacts and the frequency of the current is at least 50 kHz.

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15 148—156; 219—50