METHOD AND MACHINE FOR CORRUGATING OR PLEATING SHEET METAL

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Filed: Feb. 13, 1973

Foreign Application Priority Data
Feb. 16, 1972 France 72.5138

U.S. Cl. 72/38, 72/128, 72/202, 72/DIG. 13

Int. Cl. B21b 9/00

Field of Search 72/202, 128, 342, 364, 72/38, 179, 180, 181, 72/DIG. 13

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ABSTRACT

In order to corrugate or pleat between forming rolls sheet metal irrespective of its ductility while containing the blister formed at the end of the corrugation or pleat in the course of formation, the sheet is heated locally, at a short distance upstream of the rolls, to a temperature capable of rendering the sheet ductile. The rolls are protected against harmful heating by the distance between the heating region and the forming rolls.

6 Claims, 1 Drawing Figure
METHOD AND MACHINE FOR CORRUGATING OR PLEATING SHEET METAL

Sheet material, and more particularly stainless steel sheet material, is at the present time corrugated or pleated by deformation of a sheet between two forming rolls having conjugate shapes, namely a male roll and a female roll, in the course of which deformation a blister is formed at the end of the corrugation or pleat being formed immediately upstream of the region of the contact with the rolls (with respect to the direction of feed of the sheet) but is contained within very distinct limits.

This containment, which is preferably ensured by pressing means in rolling or sliding contact with the sheet throughout the corrugating operation permits causing the blister to perform the function of a regulator of the distribution of material and thus effectively corrugating in the cold state a large number of materials. However, certain metals, and in particular certain alloys such as titanium alloys, do not have sufficient ductility to be corrugated in this manner either because they rapidly work harden which diminishes their capacity to elongate or because they possess a large elastic return which reduces the effectiveness of the action of the rolls or because they have both these features.

An object of the present invention is to permit the treatment also of such materials and consequently to permit corrugating or pleating all kinds of metals irrespective of their initial ductility.

The present invention provides a method for corrugating or pleating sheet metal comprising passing the sheet between two forming rolls having conjugate profiles while ensuring a continuous containment of the blister, formed at the end of the corrugation or pleat in the course of formation, between limits which are fixed with respect to the region of contact between the sheet and the forming rolls, wherein the sheet is locally heated upstream of the roll contact point to a temperature capable of modifying the mechanical characteristics of the metal of the sheet and render it sufficiently ductile.

According to a preferred manner of proceeding, the heating is effected by projection of a gas brought to a high temperature upstream of the roll contact point.

The metal is thus brought to a high temperature before it is engaged and deformed by the rolls, that is to say at a point very close to the point at which the blister is formed.

The temperature must be such as to modify the mechanical characteristics of the metal and increase its ductility in such manner as to permit imparting thereto a real elongation under the action of the forming rolls, that is to say to corrugate or pleat it in the desired manner and avoid a resilient return to its initial form, that is to say to ensure that the deformation is maintained.

The heating is however carried out at a slight distance from the point of contact with the rolls so as to avoid greatly heating the rollers which would be liable to deform the sheet and adversely affect the precision of the corrugation.

Another object of the invention is to provide a machine for carrying out the method defined hereinbefore.

The invention provides a machine comprising a pair of forming rolls having conjugate profiles driven by drive means, a support for the sheet to be treated, and blister-containing means in contact with said sheet, wherein there are provided a source of gas under pressure, means for heating said gas, and a nozzle for projecting the hot gas onto the sheet upstream of the forming rolls at a slight distance from the contact of the rolls with the sheet.

Further features and advantages of the invention will be apparent from the ensuing description with reference to the accompanying drawing.

In the drawing:

The FIGURE of the drawing shows diagrammatically a machine for corrugating or pleating a sheet of metal.

This machine comprises essentially two forming rolls 1 and 2 having conjugate profiles, namely a male roll and a female roll. These rolls are driven simultaneously by a drive system 4 so as to rotate at speeds which are the same but in opposite directions. A sheet 6 to be corrugated or pleated is introduced between the rolls and maintained and guided therein by systems of which only a rod 8 carrying a wheel 9 and a lower roller 10 have been shown in the FIGURE so as to render the latter more clear. The number and disposition of these rollers and wheels depend on the dimensions and shape of the sheet.

Upstream of the rolls 1 and 2, the machine comprises a lower roller 12 and an upper roller 14 which perform the function of rollers for containing the blister 15 formed in the metal of the sheet 6 at the end of the corrugation or pleat 16 which is formed. This blister, which is constituted by the material which is upset and urged back from the point at which the rolls 1 and 2 deform the sheet, extends upstream of the sheet 6 and is strictly limited by the clamping of this sheet between the rollers 12 and 14. The upper roller 14 is movable so as to permit withdrawing it, for example when the sheet 6 is introduced in the machine. Further, the roller 14 is associated with a guide roller 18 which rolls along a previously-formed corrugation or pleat 19.

Further, a furnace 20 is mounted on the machine and heated for example by means of an electric resistance 22. The furnace has a cylindrical inner cavity 24 which is put in communication with a source of gas 26, preferably under pressure, by way of piping 28 and with a nozzle 30 by way of a pipe 32. The nozzle 30 is supported by the frame (not shown) of the machine in such manner as to open onto the sheet in the neighbourhood of the point at which the rolls 1 and 2 engage the sheet but slightly upstream of the rolls with respect to the direction of motion of the sheet through the latter.

The gas from the reservoir 26 is heated in the furnace 20 and projected under the sheet 6 just before the sheet passes between the rolls 1 and 2. The metal of the sheet is then brought locally to a high temperature which is so chosen in accordance with the nature of the metal as to impart to the latter sufficient ductility to permit its deformation, that is to say, to increase its capacity to elongate while decreasing its elasticity.

As the mechanical characteristics of the material has been modified by the heating, the sheet which passes between the rolls 1 and 2 may receive a deformation in the shape of a corrugation having a V-section or trapezoidal section corresponding to the profiles of the rolls 1 and 2 and retains this shape when it leaves the forming rolls upon cooling.
The temperature of the gas issuing from the cylindrical cavity 24 is high enough to modify the mechanical characteristics of the metal of the sheet 6 and the gas is supplied to this sheet at a slight distance from the rolls 1 and 2 so as to avoid the adverse affect the heating would have on the rolls 1 and 2 the profile of which has been determined with precision and corresponds exactly to the shape of the corrugations or pleats to be obtained. For example, to corrugate or pleat a sheet of titanium alloy, air under pressure is heated to a temperature of 400°C and then ejected by way of the nozzle 30 onto the underside of the sheet which is fed at a speed on the order of 2 metres per minute. The region of the sheet located upstream of the rollers (region indicated at 36 in the FIGURE) is then brought to a temperature of about 250°C. This very hot region is slightly upstream of the point at which the rolls 1 and 2 engage the sheet so that the rolls are not themselves brought to a temperature liable to deform them. Consequently, the profiles of the rolls remain strictly unchanged and the corrugations or pleats formed have the dimensions exactly corresponding to those of these profiles. Thus, for example, there is formed a helical corrugation having a trapezoidal section having a height of 3.70 mm and a pitch of 6.1 mm in a sheet of titanium alloy having a thickness of 0.15 mm.

It will be understood that the heating temperature depends on the nature of the metal of the sheet 6 and the thickness of this sheet.

The gas employed for the heating may be air under pressure, nitrogen, argon, or any other suitable gas. With certain metals, a jet of neutral gas permits isolating the sheet from the surrounding atmosphere and avoiding danger of oxidation by the air. In some cases, however, it may be suitable to replace the heating gas by some other heating means, for example laser, electric or any other heating means for obtaining a localized heating of a relatively small area of the sheet in the vicinity of the point at which the rolls engage the sheet and regulating the temperature of this area to the desired value.

Various other modifications may be made to the embodiment just described. For example, the furnace 20 may be replaced by another system for heating the gas.