United States Patent

Clempson

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[54] CONTINUOUS FORMING OF TRANSVERSE STIFFENING RIBS ON STRIP MATERIAL

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[52] **U.S. Cl.** **72/187**, 72/196

[51] **Int. Cl.** **B21d 13/04**

[58] **Field of Search** 72/187, 194, 196, 205, 167, 72/168

[56] **References Cited**

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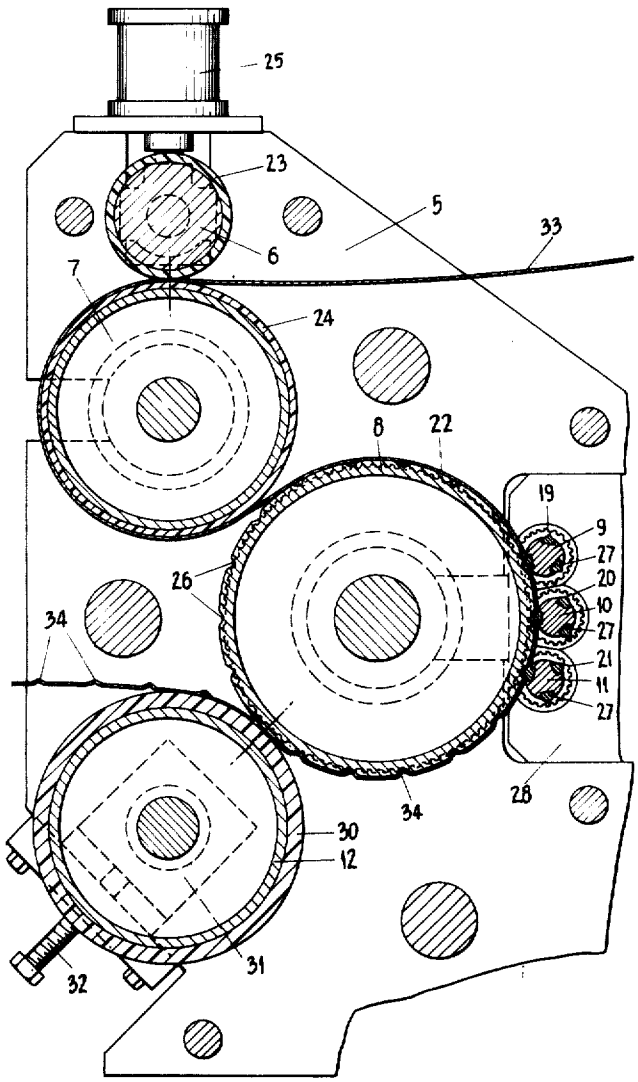
Primary Examiner—Lowell A. Larson

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[57] **ABSTRACT**

Method of and machine for forming transverse ribs in metal strip wherein the strip is fed through a pair of back tension rolls, over a die roll having a series of elliptical shaped recesses extending transversely of and around the periphery of the die roll, a series of rotary punch rolls engaging the strip on the die roll and deforming the strip into the recesses, a forward tension roll engaging the deformed strip on the die roll and controlling the feed out of strip from the machine, the back tension rolls and the forward tension roll being driven by gearing providing a speed differential between these rolls and thus indicating tension in the strip as it passes over the die roll.

12 Claims, 3 Drawing Figures



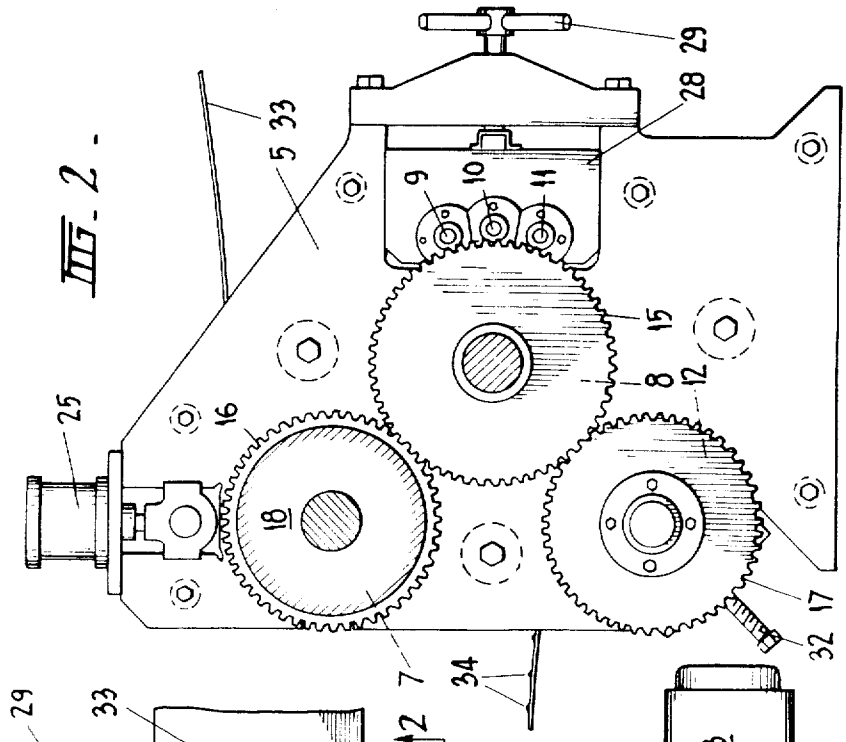

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FIG. 2.

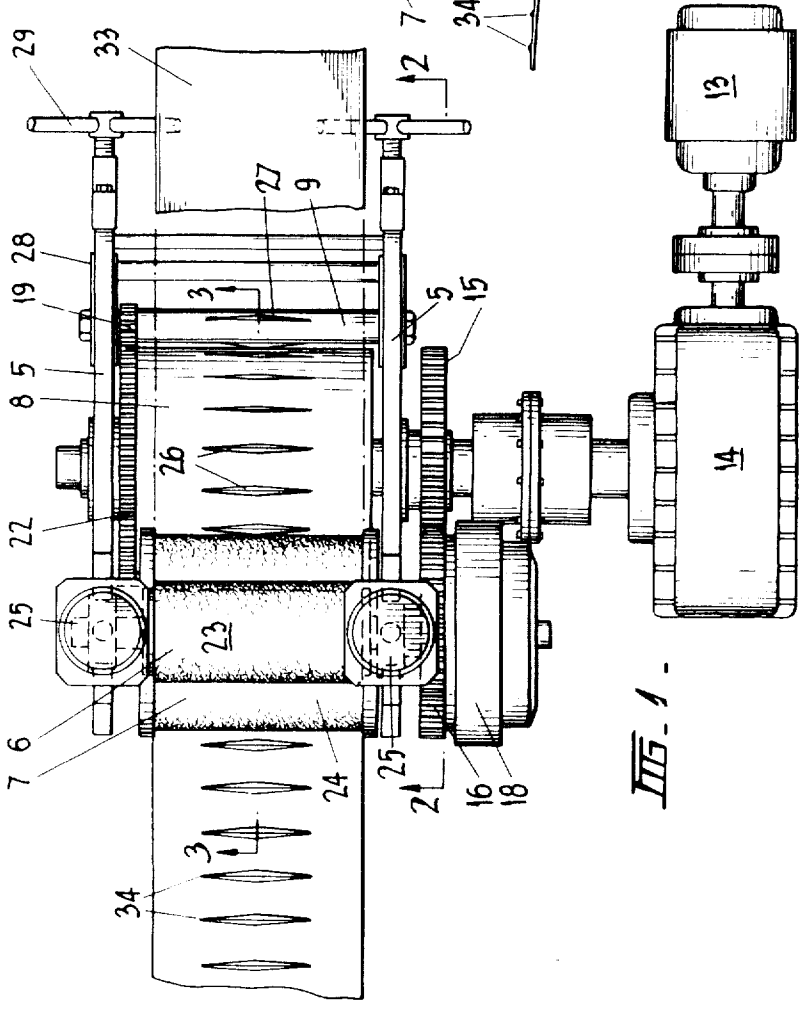

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FIG. 1.

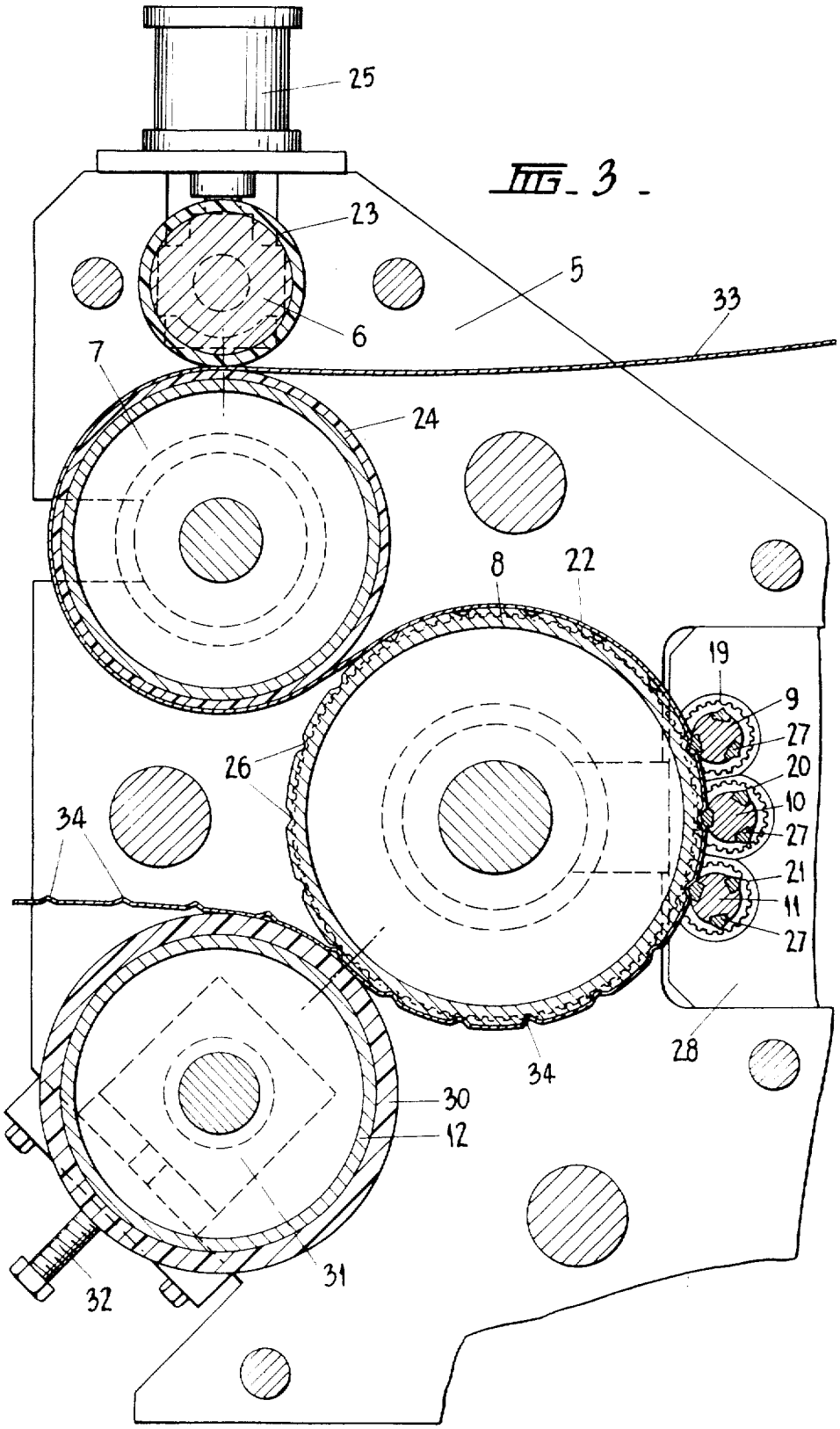


FIG. 3

CONTINUOUS FORMING OF TRANSVERSE STIFFENING RIBS ON STRIP MATERIAL

BACKGROUND OF INVENTION

This invention relates to a method and apparatus for forming transverse stiffening ribs on strip material, in particular on coils or lengths of metal strip, suitable for subsequent forming into decking, tiling, walling, cladding, flooring, concrete framework and other building structure forms.

Structural members or panels of this general type as heretofore used have consisted of a sheet or strip of material provided with upstanding ribs or flanges along its longitudinal edges to enable adjacent panels to be joined along said edges and to stiffen and increase the load bearing capacity of the panels. Further longitudinally extending ribs or flanges have been provided in the pan of the panel for additional stiffening purposes.

In use these prior known panels have a number of disadvantages. One major disadvantage is that the ribs are mainly effective only as stiffeners and increase the load bearing capacity of the panel or multiple panel structure only in the region or near the vicinity of the ribs. This has of consequence required the basic design of the known panels to be limited to the provision of a comparatively short pan width between the jointed or interlocking edge ribs or the provision of intermediate longitudinal ribs between the edge ribs of each panel, resulting in a number of pans of narrow width in each panel, with an increased use of material.

The provision of transverse ribs in structural members or panels of the above general type in place of the longitudinal stiffening ribs results in a load bearing structure wherein all loading over the panel is transferred to the edge ribs thereby allowing greater span between the ribs with considerable saving in material, even if the edge ribs are made heavier than known ribs, and results in a stronger, more economical and efficient structure with the advantage of the pan portion being plate-like in performance.

In order to economically produce such transversely-ribbed structural members or panels, the transverse rib forming operation of necessity should be carried out continuously on a length or coil of the metal strip. Press techniques are known employing pressure plates to obviate web deformation but the use of pressure plate equipment and press techniques to produce structurally suitable transverse ribs at close centers continuously at speeds up to one hundred and fifty feet per minute has been found to be impractical.

In order to provide the type of web restraint available with pressure plates, but on a continuous forming basis and at the order of speed quoted above, applicant has devised a stretch-forming technique in a transverse rib forming machine through which strip could be passed at suitable production speeds, and at the same time inducing tension in the web up to and beyond, if necessary, the yield point of the metal, the tension being considered as a continuously available alternative for the function provided by pressure plates.

According to the present invention there is provided a method of continuously forming transverse ribs in metal strip comprising the steps of feeding the strip through a transverse rib forming machine, applying tension to the strip over a die roll in the machine, and rotary punch forming ribs in the strip at a region of said applied tension.

The tension may be induced in the strip by applying a controlled speed differential between the input and output feed rolls of the machine, and the forming operation may be performed by a plurality of rotary punch rolls arranged around a peripheral section of the die roll over which the strip passes.

According to a further aspect of the invention there is provided a transverse rib forming machine for continuously forming transverse ribs in a metal strip, comprising strip feed-in rolls, a die roll arranged parallel to and spaced from said feed-in rolls and having a series of recesses arranged around its peripheral surface, at least one rotary punch roll arranged so as to be in forming engagement with the strip passing over the die roll and a take-off roll arranged so as to be in frictional engagement with the formed strip and the die roll, said feed-in rolls and the take-off roll having a drive arrangement providing a speed differential therebetween so as to induce tension in the strip as it passes over the die roll.

The feed-in rolls and the take-off roll may each be provided with an elastomer surface to prevent undesirable slippage of the strip and consequential loss of tension over the die roll.

A plurality of rotary punch rolls may be provided around a section of the periphery of the die roll so as to facilitate formation of the ribs by gradual deformation.

In order that the invention and its manner of performance may be more fully described, reference will now be made to embodiment of the invention as illustrated in the accompanying drawings in which:

FIG. 1 is a plan view of the apparatus of the invention.

FIG. 2 is a part sectional side view taken along line 2—2 of FIG. 1, and

FIG. 3 is a sectional side view taken along the line 3—3 of FIG. 1.

Referring to the drawings, the apparatus includes roll supporting side frames 5 connected by star bars or the like. Mounted between frames 5 for rotation therein are nip roll 6 and back tension roll 7, die roll 8, rotary punch rolls 9, 10 and 11 and forward tension roll 12.

Die roll 8 is driven by a variable speed electric motor 13 through reduction gearing 14. Pinion gear 15 on the die roll drive shaft meshes with gear 16 of back tension roll 7 and gear 17 of forward tension roll 12. The drive through to back tension roll 7 is by way of a slipping clutch 18, and the gearing is such that back tension roll 7 tends to be driven so that its surface speed is slower than the surface speed of die roll 8.

Rotary punch rolls 9, 10 and 11 are driven through pinions 19, 20 and 21 and pinion 22 on the die roll shaft.

Nip roll 6 and back tension roll 7 are each provided with an elastomer surface 23, 24 and roll 6 is mounted for movement towards and away from roll 7 by fluid pressure rams 25 mounted on side frames 5.

Die roll 8 is provided on its peripheral surface with diamond or elliptical shaped recesses 26 having their greatest depth at the center and reducing in depth and width towards the sides of the die roll and rotary punch rolls 9, 10 and 11 are provided with projecting punches 27 spaced around the punch rolls so as to mate with the die roll recesses 26 during operation of the apparatus. Punch rolls 9, 10 and 11 are mounted as an assembly on sliding blocks 28 for adjustment towards and away from die roll 8 by means of adjusting screw handles 29 or if desired, fluid pressure ram means.

Forward tension roll 12 is also provided with an elastomer surface 30 and is adjustable towards and away from die roll 8 on sliding bearing blocks 31 through adjusting screws 32. Fluid pressure rams may also be substituted for screws 32, if desired.

Rotary punch rolls 9, 10 and 11 may be provided with back up rolls (not shown) acting in known manner to counteract any tendency of the punch rolls to deflect under high pressure.

In operation, strip 33 is fed between rolls 6 and 7, around roll 7 and on to die roll 8, past rotary punch rolls 9, 10 and 11 and out between die roll 8 and forward tension roll 12.

With the strip passed through the apparatus, roll 6 is engaged with roll 7 through fluid pressure rams 25 and forward tension roll 12 is engaged against die roll 8. Roll 12 engages die roll 8 at a relatively high pressure to induce sufficient friction on the strip between these rolls so as to obviate any slip back of the strip towards the punch rolls.

By reason of the speed differential set up through the apparatus and slipping clutch 18, tension is built up in the strip from the nip between rolls 6 and 7 to the area of transfer of the strip to die roll 8 where the strip is laid on the die roll under the required degree of tension and is held under that degree of tension until it passes through the nip between forward tension roll 12 and die roll 8.

As the strip passes between rotary punch rolls 9, 10 and 11 and die roll 8, the rotary punch rolls form the ribs to depth.

Further nip rolls may be located so as to engage against the strip on the die roll between the rotary punch rolls and either or both the back tension and forward tension rolls so as to induce additional friction between the formed strip and the die roll.

Although only three rotary punch rolls are illustrated in the drawings, four or more punch rolls may be employed to facilitate accurate forming.

I claim:

1. A forming machine for continuously forming transverse ribs in a metal strip, comprising strip back tension rolls, a die roll arranged parallel to and spaced from said back tension rolls and having a series of recesses arranged around its peripheral surface, at least one rotary punch roll arranged so as to be in forming engagement with the strip passing over the die roll, and a forward tension roll arranged so as to be in frictional engagement with the formed strip and the die roll, said back tension rolls and the forward tension roll having a drive arrangement providing a speed differential therebetween so as to induce tension in the strip as it passes over the die roll.

2. A machine according to claim 1 wherein the peripheral surfaces of the back tension rolls and the forward tension roll are of elastomer material.

3. A machine according to claim 1 wherein a plurality of rotary punch rolls are provided around a section of the periphery of the die roll.

4. A machine according to claim 3 wherein the rotary punch rolls are each provided with at least one punch member, the dimensions of the punches varying between the first punch roll and the last punch roll so as to form the ribs by gradual deformation.

5. A machine according to claim 4 wherein the punch rolls are provided with back-up rolls so as to counteract any tendency of the punch rolls to deflect under forming pressure.

6. A machine according to claim 1 wherein the drive arrangement comprises a variable speed motor driving the die roll which is in driving engagement with the back tension rolls, forward tension roll and rotary punch roll or rolls by means of gear pinions, said drive from the die roll to the back tension rolls also incorporating a slipping clutch.

7. A machine according to claim 1 wherein the back tension rolls are adjustably mounted with respect to each other and the forward tension roll and rotary punch roll or rolls are adjustably mounted with respect to the die roll.

8. A machine according to claim 1 wherein the die roll recesses are of elliptical or diamond shape having their greatest depth at the center and reducing in depth and width towards the sides of the die roll.

9. A machine according to claim 7 and including an additional nip roll located between the rotary punch roll or rolls and the forward tension roll so as to engage against the formed strip on the die roll and induce additional friction between the strip and the die roll.

10. A machine according to claim 7 and including an additional nip roll located between the rotary punch roll or rolls and the back tension roll so as to engage against the formed strip on the die roll and induce additional friction between the strip and the die roll.

11. A machine according to claim 7, including additional nip rolls located between the rotary punch roll or rolls and the forward and back tension rolls so as to engage against the formed strip on the die roll and induce additional friction between the strip and the die roll.

12. A method of continuously forming transverse ribs in metal strip comprising the steps of feeding the strip through a transverse rib forming machine, applying tension to the strip over a die roll in the machine by applying a controlled speed differential between input and output rolls of the machine, and rotary punch forming ribs in the strip at a region of said applied tension by a plurality of punch rolls arranged in forming engagement with and around a peripheral section of the die roll and synchronized for rotation with said die roll.

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