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(54) **System for grooving and rolling linear member and flat heat exchanger tube resulting therefrom**

System zum Nuten und Walzen von länglichen Körpern und daraus entstehende flache Rohre für Wärmeaustauscher

Système pour le rainurage et le laminage de corps linéaires et tubes plats pour échangeur de chaleur en résultant

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(56) References cited:
EP-A- 0 522 985
GB-A- 1 468 710
US-A- 2 047 001
US-A- 2 549 466
US-A- 3 662 582

- **PATENT ABSTRACTS OF JAPAN vol. 9, no. 264 (M-423)(1987) 22 October 1985**
- **PATENT ABSTRACTS OF JAPAN vol. 16, no. 450 (M-1312)18 September 1992**
- **PATENT ABSTRACTS OF JAPAN vol. 7, no. 149 (M-225)30 June 1983**

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Description

The present invention relates generally to a system for grooving and rolling a sheet metal according to the preamble of claim 1, as it is known from JP-A-4 157 017, and more particularly to the same used in a prewelding process upon manufacture of a heat exchanger tube with grooved inner surface for a heat exchanger for an air conditioner, and a flat heat exchanger tube resulting therefrom.

An air conditioner for domestic use has been reduced in size to make a living space comfortable. The reduction in size of the air conditioner is obtained by decreasing the entirety of component parts.

The air conditioner has a heat exchanger part which occupies a large part therein, and includes a heat exchanger tube through which heating medium passes, the heat exchanger tube being made of copper with excellent heat conductivity, and having an inner surface with grooves formed, for example, in a spiral, so as to largely improve the efficiency.

As to a common method of manufacturing the heat exchanger tube with grooved inner surface, a billet is subjected to extrusion, rolling, and drawing in turn, then grooved, obtaining a seamless copper tube.

In recent years, for obtaining a small diameter heat exchanger tube with grooved inner surface, a method as shown in Fig. 7 becomes often adopted in which an original sheet metal 10 is subjected to grooving/rolling by a grooved rolling part 21, and shaped into a tube by a tube forming part 22, a butt portion thereof being welded by a seam welding equipment 23 to obtain a welded heat exchanger tube 13.

The method on high frequency welding enables a reduction in diameter of the copper tube as compared with the seamless method, resulting in an advantage in connection with countermeasures against a reduction in size of the heat exchanger part.

On the other hand, an air conditioner for use in a motor vehicle includes a heat exchanger having harmonica tubes 25 obtained by extrusion molding of aluminum as shown in Fig. 8A, or inner fin tubes 26 each obtained by inserting a wavy fin or rib 28 into an aluminum flat tube 27 subjected to high frequency welding which are soldered as shown in Fig. 8B, and outer fins 29 superimposed alternately as shown in Fig. 8C. This air conditioner is used in ventilating a portion of the outer fins 29.

As compared with the seamless heat exchanger tube, that one produced by high frequency welding has a welded portion which needs ensured reliability.

For obtaining sure welding, conditions necessary to welding should be satisfied. For this purpose, some conditions necessary to welding but, actually, with possible deviation from a proper value should be eliminated.

The principal conditions of welding are as follows: 1) welding temperature which depends on heat input, speed, thickness, approach angle, and resistance; 2) butt which depends on parallel butt and pressure welding width which in turn depends on width, thickness, preforming, and slit shape; 3) atmosphere which depends on non-oxidation which in turn depends on Argon (Ar) gas flow.

Control for input heat of 1) is carried out in using various fluctuation factors, and control methods for the welding temperature of 1) and the welding atmosphere of 3) are established.

As to a control method for butt, control should be carried out in processes of rolling of the sheet metal, and shaping and roll forming of slits or grooves, however, control on detected fluctuation factors cannot currently be adopted. Up to the present, it is carried out in accordance with inspection of a size of the sheet metal and a section of the slit to select nondefectives which may have a practical tolerance of accuracy or dispersion.

The most important factors are conditioning of an edge of an edge portion of the sheet metal, width thereof, and circular forming of the edge portion. Ordinarily, this is ensured by improvement in accuracy of slit cutting and design of a roll groove shape for roll forming. Thus, a method is adopted that after carrying out grooving/rolling of the sheet metal out of a line, slit cutting is carried out on the entirety of the width thereof on the line. On the other hand, a groove shaping method for the sheet metal is proposed which carries out circular forming of the edge portion (see, for example, JP-A 4-157017). However, this method is still unsatisfying due to dispersion of a width and end face shape of the sheet metal.

Therefore, when carrying out roll forming and welding, the sheet metal grooved according to the actual groove shaping method has welds unstable and insufficient in strength, resulting in impossible elimination of secular dispersion.

On the other hand, preparation is made actually for using, as a heat exchanger cooling medium, substitute freon which decomposes before reaching the ozone layer in place of freon which destroys same.

However, since substitute freon has about 20 % reduced heat exchanger characteristic, countermeasures should be taken in view of total abolition of the use of freon.

Moreover, with substitute freon, a heat exchanger area of the heat exchanger tube should be increased by a reduced part of heat exchanger characteristic, which produces a problem of a weight and size thereof. Therefore, performance of the heat exchanger tube should be improved to fully compensate a reduction in heat exchanger characteristic.

It is, therefore, an object of the present invention to provide a system for grooving and rolling a sheet metal without any dispersion of a width and end face shape thereof and with sufficient heat exchanger characteristic, and a flat heat exchanger tube resulting therefrom.

According to the present invention, the system for grooving and rolling a sheet metal described in the preamble of claim 1 is characterized by the features of the characterizing portion of claim 1.

Fig. 1A is a sectional view showing a groove forming system according to a first preferred embodiment of the present invention;
Figs. 1B and 1C are views similar to Fig. 1A. each showing the edge rolling part of the system according to the first preferred embodiment;
Fig. 2A is a view similar to Fig. 1C, showing an original sheet metal according to the first preferred embodiment;
Fig. 2B is a view similar to Fig. 2A, showing a sheet metal grooved and rolled with the system according to the first preferred embodiment;
Fig. 3A is a view similar to Fig. 2B, showing groove forming system according to a second preferred embodiment of the present invention;
Figs. 3B and 3C are views similar to Fig. 3A, each showing edge rolling part of the system according to the first preferred embodiment;
Fig. 4A is a view similar to Fig. 3C, showing an original sheet metal according to the second preferred embodiment;
Fig. 4B is a view similar to Fig. 4A, showing a sheet metal grooved and rolled with the system according to the second preferred embodiment;
Fig. 5A is an enlarged fragmentary section showing a flat heat exchanger tube according to the second preferred embodiment;
Fig. 5B is an enlarged view of a portion "a" in Fig. 5A;
Fig. 6A is a perspective view showing a flat tube and a wavy fin to be inserted therein;
Fig. 6B is a view similar to Fig. 6A, showing the flat tube with the wavy fin inserted;
Fig. 7 is a schematic view showing a method of manufacturing a heat exchanger tube with grooved inner surface;
Figs. 8A and 8B are view similar to Fig. 6B, each showing a known heat exchanger tube for an automotive air conditioner; and
Fig. 8C is a fragmentary side view showing a known heat exchanger.

Referring to the drawings wherein like reference numerals designate like parts throughout the views, preferred embodiments of the present invention will be described.

Referring to Figs. 1A to 2B, there is shown a first preferred embodiment wherein reference numerals 1 and 8 designate a groove forming roll and a support roll, respectively, in a system for grooving and rolling a sheet metal. 10 designates an original sheet metal, and 11 designates a sheet metal rolled and grooved.

Referring particularly to Fig. 1A, the groove forming roll 1 comprises a groove forming part 1A, and edge rolling parts 1B disposed on both ends thereof. The groove forming part 1A is provided with a plurality of grooving protrusions 2 with a pitch p, a height h_2 and an inclination angle θ, and a section formed substantially in a trapezoid, and a lower protrusion 3 located in the center of the groove forming part 1A for contacting a surface of the original sheet metal upon grooving/rolling.

Referring to Fig. 1B, each edge rolling part 1B comprises a small diameter portion 7 connected to a base portion of the grooving protrusion 2' disposed at an end of the groove forming part 1A, and an end rolling part 5 having a bevel portion. A width w_2 of the small diameter portion 7 is larger than a width w_1 of a groove portion 4 of the groove forming part 1A.

The support roll 8 is provided with flanges 9 at both ends thereof for arresting elongation of the sheet metal in the cross direction thereof upon grooving/rolling. A height of the flange 9 is determined so that when the flange 9 comes in contact with the end rolling part 5 of the groove forming roll 1, a distance between the grooving protrusion 2' of the groove forming part 1A and a surface of the support roll 8 is equal to a predetermined thickness t_{min} of each groove 12 of the sheet metal 11 grooved and rolled.

Referring to Fig. 1C, the width w_2 of the small diameter portion 7' connected to the base portion of the grooving protrusion 2' of the edge rolling part 1B is not equal to the width w_1 of the groove portion 4 of the groove forming part 1A, while a diameter of the small diameter portion 7' is smaller than a diameter of the groove portion 4.

The groove forming roll 1 and the support roll 8 are disposed so that the flanges 9 of the support roll 8 contact the end rolling part 5 of the groove forming roll 1 constructed as described above, which are rotated so that the original sheet metal 10 as shown in Fig. 2A passes therebetween for grooving/rolling.

When the original sheet metal 10 comes between the rolls 1 and 8, each grooving protrusion 2 of the groove forming part 1A presses the surface of the original sheet metal 10 to obtain the thickness t_{min}, thus forming the groove 12.

Referring to Fig. 1A, a portion of the sheet metal extruded from the groove 12 by the grooving protrusion 2 serves to come in the groove portion 4 of the groove forming roll 1 in increasing a thickness of an adjacent portion thereof, forming a protrusion portion with a thickness t_{max}. A portion of the sheet metal metal which could not come in the groove portion 4 due to a greater thickness t_0 of the sheet metal than a reference value, etc. moves in the cross direction of the sheet metal so as to come in a clearance g_1 which is formed on both sides of the lower protrusion 3 disposed in the center of the groove forming roll 1.

That is, as best seen in Fig. 2B, the clearance g_1 serves as a buffer area C_1 for alleviating elongation of the sheet metal 11 in the cross direction thereof.

Referring to Fig. 1B, simultaneously with grooving, both ends of the sheet metal 11 are rolled by the end rolling part 1B. However, since elongation of the sheet metal 11 in the cross direction thereof by rolling is arrested by the flanges 9 of the support roll 8, a portion of the sheet metal extruded in the same way as described above with a greater volume than a reference value comes in a clearance g_2 formed in the small diameter portion 7.

That is, as best seen in Fig. 2B, the clearance g_2 also serves as a buffer area C_2 for alleviating elongation of the linear member 11 in the cross direction thereof.

According to this embodiment, since elongation of the sheet metal in the cross direction thereof produced upon grooving/rolling can be not only restricted by the support roll 8, but absorbed by the buffer areas C_1, C_2, the sheet metal 11 grooved and rolled presents no dispersion of a width and end face shape even if the original sheet metal 10 has some dispersion of a thickness, width, etc. It is to be noted that in Figs. 1A to 2B, reference numeral A designates a groove portion of the sheet metal 11, and B designates an edge portion thereof.

When the groove forming roll 1 is used which has the grooving protrusion 2 with the pitch p of 0.55 mm on average, the height h_2 $(= t_{max} - t_{min})$ of 0.16 mm, and the inclination angle θ of about 10°, and the original sheet metal 10 made of phosphor deoxidized copper and with the thickness of 0.3 mm and the width of 20.8 mm is subjected to grooving/rolling out of a line, the sheet metal 11 is obtained which has a groove pitch of 0.55 mm on average, a thickness t_{max} of 0.38 mm and t_{min} of 0.22 mm, and a groove angle 10°.

This sheet metal 11 grooved and rolled is subjected to roll forming on the entirety of the outer periphery thereof so as to obtain a finished tube with a diameter of 6.35 mm. Then, a butt portion of the sheet metal 11 is subjected to high frequency welding by a seam welding equipment.

In this case, since grooving/rolling ensures forming of the grooves 12 with a width regulated accurately at a certain value, welding can be carried out with less butt dispersion based on roll forming on the entirety of the outer periphery of the linear member 11, i.e., a butt angle of ± 2° (+ 20°, - 0° in the prior art) and a height dispersion of ± 0.1 mm (± 0.25 mm in the prior art).

Thus, not only welding is largely improved in strength, but in quality for a long period of time, i.e., one defect per 50 Km (one defect per 10 Km in the prior art), resulting in largely increased and stabilized reliability of welding quality. Moreover, a yield is improved from prior art 80 % to 95 %.

Since the system is less adjusted with material variations, an operation rate thereof is increased from prior art 70 % to 95 %.

Moreover, due to less butt angle and height dispersion, a life of consumables is considerably improved, e.g., for a seam guide, 100 hours - 400 hours, and for a squeeze roll, 400 hours - 800 hours.

According to this embodiment, the linear member 11 has the buffer area C_1 disposed in the center thereof as shown in Fig. 1A, and the buffer area C_2 disposed on the side end thereof as shown in Figs. 1B and 1C. Alternatively, the sheet metal 11 may has either of the buffer areas C_1, C_2.

Moreover, according to this embodiment, the grooving protrusion 2 of the groove forming roll 1 is shaped in a trapezoid for obtaining a trapezoidal groove, however, it may be freely selected. For this grooving/rolling, it is important to satisfy the following conditions:

a) The grooves 12 of the sheet metal are symmetrically formed,
b) The groove forming roll 1 has in the cross direction thereof at least one buffer area which continues in the longitudinal direction of the sheet metal,
c) The groove forming roll 1 or the support roll 8 has on both ends thereof flange portions for arresting extension of the sheet metal in the cross direction thereof, and
d) A thickness t_e of the end portion of the sheet metal is: $(t_{max} + t_{min})/2 \geqq t_e > t_{min}$.

Referring next to Figs. 3A to 4B, there is shown a second preferred embodiment of the present invention.

Referring particularly to Fig. 3A, reference numeral 1' designates a groove forming roll for a sheet metal for an inner fin type welded flat heat exchanger tube, and 4' designates a shallow and flat groove portion located at a predetermined pitch position in a groove portion 4 of a groove forming roll 1'.

Referring to Figs. 4A and 4B, 10' designates an original aluminum sheet metal, 11' designates an aluminum sheet metal formed by the groove forming roll 1', and 16 designates a soldering protrusion formed by the groove portion 4' of the groove forming roll 1'.

The other constitution is substantially the same as the first preferred embodiment except that the groove forming roll 1' and a width thereof are slightly different from that ones as shown in Figs. 1A to 1C.

In the same manner as the first preferred embodiment, the original sheet metal 10' is grooved and rolled by the groove forming roll 1' to obtain the sheet metal 11'. The sheet metal 11' is subjected to roll forming on the entirety of the outer periphery thereof so as to form a flat tube. Then, a butt portion of the sheet metal 11' is subjected to high frequency welding by the seam welding equipment, obtaining a flat tube with grooved inner surface.

Referring to Figs. 5A to 6B, this flat tube with grooved inner surface 15 is cut to a predetermined length (between about 150 mm and 500 mm) so as to fit a length of an automotive air conditioner. A solder 18 is placed on inner and outer surfaces of the flat tube 15 as best seen in Fig. 5B, and a wavy fin 17 with the solder 18 placed and substantially the same length as the flat tube 15 is inserted therein so that each convex portion thereof contacts the corresponding soldering protrusion 16 as best seen in Figs. 5A and 6A.

The flat tube 15 having the wavy fin 17 inserted is heated in a furnace so that the convex portion of the wavy fin 17 is soldered to the corresponding soldering protrusion 16 on the inner surface of the flat tube 15, obtaining an inner fin type flat heat exchanger tube with grooved inner surface 14 as shown in Fig. 6B.

When the groove forming roll 1 is used which has the grooving protrusion 2 with the pitch p of 0.55 mm on average, the height h_2 (= t_{max} - t_{min}) of 0.16 mm, and the inclination angle θ of about 10°, and the original sheet metal 10' made of three-layer clad aluminum and with the thickness of 0.3 mm and the width of 42.2 mm is subjected to grooving/rolling out of a line, the sheet metal 11' is obtained which has the groove pitch of 0.55 mm on average, the thickness t_{max} of 0.38 mm and t_{min} of 0.22 mm, and the groove angle 10°.

This sheet metal 11 grooved and rolled is subjected to roll forming on the entirety of the outer periphery thereof, which is formed in a flat shape so as to obtain a finished flat tube with long diameter of 20 mm x small diameter of 2 mm. Then, a butt portion of the sheet metal 11' is subjected to high frequency welding by the seam welding equipment.

In this case, since grooving/rolling ensures forming of the grooves 12 with a width regulated accurately at a certain value, welding can be carried out with less butt dispersion based on roll forming on the entirety of the outer periphery of the sheet metal 11', i.e., the butt angle of ± 2° (+ 20°, - 0° in the prior art) and the height dispersion of ± 0.1 mm (± 0.25 mm in the prior art).

Thus, not only welding is largely improved in strength, but in quality for a long period of time, i.e., one defect per 50 Km (one defect per 10 Km in the prior art), resulting in largely increased and stabilized reliability of welding quality. Moreover, a yield is improved from prior art 83 % to 98 %.

Since the system is less adjusted with material variations, an operation rate thereof is increased from prior art 72 % to 97 %.

Moreover, due to less butt angle and height dispersion, a life of consumables is considerably improved, e.g., for a seam guide, 350 hours - 920 hours, and for a squeeze roll, 800 hours - 3000 hours.

According to this embodiment, the sheet metal 11' has the buffer area C_1 disposed in the center thereof as shown in Fig. 3A, and the buffer area C_2 disposed on the side end thereof as shown in Figs. 3B and 3C. Alternatively, the sheet metal 11' may have either of the buffer areas C_1, C_2.

Moreover, according to this embodiment, the grooving protrusion 2 of the groove forming roll 1' is shaped in a trapezoid for obtaining a trapezoidal groove, however, it may be freely selected. For this grooving/rolling, it is important to satisfy the following conditions:

a) The grooves 12 of the sheet metal are symmetrically formed, except ones to be soldered to the fin 17,

b) The groove forming roll 1' has in the cross direction thereof at least one buffer area which continues in the longitudinal direction of the sheet metal, and

c) The groove forming roll 1' or the support roll 8 has on both ends thereof flange portions for arresting extension of the sheet metal in the cross direction thereof.

Having described the present invention in connection with the preferred embodiments, it is to be noted that the present invention is not limited thereto, and various changes and modifications are possible without departing from the scope of the present invention as defined by the claims.

Claims

1. A system for grooving and rolling a sheet metal (10), the system including a first roll (1) having a central groove forming portion (1A) provided with a plurality of annular forming protrusions (2) alternated with annular forming surfaces (4) of smaller diameter, the central groove forming portion (1A) being symmetrical with regard to a central plane of symmetry of the first roll (1) which is perpendicular to its longitudinal axis, the first the first roll (1) further having edge rolling portions (1B) symmetrically disposed on both sides of the central groove forming portion (1A), the system further including a second roll (8) disposed opposite and parallel to the first roll (1), characterized in that the first (1) and second (8) roll are adapted in such manner, that if, in use, said sheet metal (10) is fed through the gap in between of the first (1) and second (8) roll, there is at least one longitudinally extending zone, the lateral position of which corresponds to a predetermined longitudinal portion (C_1, C_2) of said first roll (1), said zone failing to be deformed into full contact with said annular forming surface (4) in the region of said predetermined longitudinal portion of said first roll (1), and
that the system further includes means (9) for restraining elongation of said sheet metal (10) in the longitudinal direction of said first roll (1).

2. A system as claimed in claim 1, characterized in that one of said plurality of annular forming protrusions (2) is disposed on the central plane of symmetry, the center of said central groove forming portion (1A) being selected as said at least one predetermined longitudinal portion (C_1) of said first roll (1), such by means of a reduction of the radius of a centrally located annular forming protrusion (3).

3. A system as claimed in claim 1, characterized in that two (C_2) of said predetermined longitudinal portions (C_1, C_2) of said first roll (1) are selected to be each between one of said edge rolling portions (1B) and an adjacent one (2') of said plurality of annular forming protrusions (2) of said first roll (1).

4. A system as claimed in claim 1, characterized in that said restraining means (9) are in the form of two flanges, each flange being mounted on a longitudinal end of said first roll (1).

5. A system as claimed in claim 1, characterized in that said restraining means (9) are in the form of two flanges, each flange being mounted on a longitudinal end of said second roll (8).

6. A system as claimed in claim 1, characterized in that said annular forming protrusions (2) of said central groove forming portion (1A) are disposed with a constant pitch.

7. A system as claimed in claim 1, characterized in that said plurality of annular forming protrusions (2) have a pitch of 0,55 mm on average, a height of 0.16 mm and an angle of inclination of 10°.

Patentansprüche

1. Ein System zum Nuten und Walzen eines Bleches (10), wobei das System eine erste Walze (1) mit einem zentralen Nutformungsteil (1A) umfaßt, der mit einer Vielzahl von ringförmigen Formungsvorsprüngen (2) versehen ist, die sich mit ringförmigen Formungsoberflächen (4) mit kleinerem Durchmesser abwechseln, wobei der zentrale Nutformungsteil (1A) symmetrisch hinsichtlich einer zentralen Symmetrieebene der ersten Walze (1) ist, welche senkrecht auf ihrer longitudinalen Achse steht, die erste Walze (1) weiter Kantenwalzteile (1B) aufweist, die symmetrisch auf beiden Seiten des zentralen Nutformungsteils (1A) angeordnet sind, das System weiter eine zweite Walze (8) umfaßt, die gegenüber und parallel zu der ersten Walze (1) angeordnet ist, dadurch gekennzeichnet, daß die erste (1) und zweite (8) Walze derart ausgelegt sind, daß dann, wenn, im Gebrauch, das Blech (10) durch den Spalt zwischen der ersten (1) und zweiten (8) Walze eingespeist wird, es wenigstens eine sich longitudinal erstreckende Zone gibt, deren seitliche Position einem vorbestimmten longitudinalen Teil (C_1, C_2) der ersten Walze (1) entspricht, wobei die Zone nicht in vollen Kontakt mit der ringförmigen Formungsoberfläche (4) in dem Bereich des vorbestimmten longitudinalen Teils der ersten Walze (1) verformt werden kann, und daß das System weiter Mittel (9) zum Zurückhalten der Längung des Bleches (10) in der longitudinalen Richtung der ersten Walze (1) umfaßt.

2. Ein System wie in Anspruch 1 beansprucht, dadurch gekennzeichnet, daß einer der Vielzahl von ringförmigen Formungsvorsprüngen (2) auf der zentralen Symmetrieebene angeordnet ist, wobei die Mitte des zentralen Nutformungsteils (1A) als der wenigstens eine vorbestimmte longitudinale Teil der ersten Walze (1), wie mittels einer Verringerung des Radius eines zentral angeordneten ringförmigen Formungsvorsprunges (3), ausgewählt ist.

3. Ein System wie in Anspruch 1 beansprucht, dadurch gekennzeichnet, daß zwei (C_2) der vorbestimmten longitudinalen Teile (C_1, C_2) der ersten Walze (1) ausgewählt sind, sich jeweils zwischen einem der Kantenwalzteile (1B) und einem benachbarten (2') der Vielzahl von ringförmigen Formungsvorsprüngen (2) der ersten Walze (1) zu befinden.

4. Ein System wie in Anspruch 1 beansprucht, dadurch gekennzeichnet, daß die Rückhaltemittel (9) die Form von zwei Flanschen aufweisen, wobei jeder Flansch auf einem longitudinalen Ende der ersten Walze (1) befestigt ist.

5. Ein System wie in Anspruch 1 beansprucht, dadurch gekennzeichnet, daß die Rückhaltemittel (9) die Form von zwei Flanschen aufweisen, wobei jeder Flansch auf einem longitudinalen Ende der zweiten Walze (8) befestigt ist.

6. Ein System wie in Anspruch 1 beansprucht, dadurch gekennzeichnet, daß die ringförmigen Formungsvorsprünge (2) des zentralen Nutformungsteils (1A) mit einer konstanten Teilung angeordnet sind.

7. Ein System wie in Anspruch 1 beansprucht, dadurch gekennzeichnet, daß die Vielzahl von ringförmigen Formungsvorsprüngen (2) eine Teilung von 0,55 mm im Durchschnitt, eine Höhe von 0,16 mm und einen Neigungswinkel von 10° aufweist.

Revendications

1. Système pour rainurer et rouler une tôle de métal (10), le système comprenant un premier rouleau (1) ayant une partie centrale de formation de rainures (1A) pourvue d'une pluralité de saillies de formage annulaires (2) qui alternent avec des surfaces de formage annulaires (4) de diamètre inférieur, la partie centrale de formage de rainures (1A) étant symétrique par rapport à un plan de symétrie central du premier rouleau (1) qui est perpendiculaire à son axe longitudinal, le premier rouleau (1) comportant en outre des parties de roulage de bordure (1B) disposées de façon symétrique sur les deux côtés de la partie centrale de formation de rainures (1A), le système comprenant en outre un second rouleau (8) disposé à l'opposé et parallèle au premier rouleau, caractérisé en ce que le premier rouleau (1) et le second rouleau (8) sont adaptés de telle manière que si, en utilisation, ladite tôle de métal (10) est amenée à travers l'intervalle entre le

premier rouleau (A) et le second rouleau (8), il existe au moins une zone longitudinale dont la position latérale correspond à une partie longitudinale prédéterminée (C1, C2) dudit premier rouleau (1), ladite zone n'étant pas déformée jusqu'en contact total avec ladite surface de formage annulaire (4) dans la région de ladite partie longitudinale prédéterminée dudit premier rouleau (1), et en ce que le système inclut en outre des moyens (9) pour restreindre l'élongation de ladite tôle de métal (10) dans la direction longitudinale dudit premier rouleau (1).

2. Système selon la revendication 1, caractérisé en ce que l'une desdites saillies de formage annulaires (2) parmi ladite pluralité est disposée sur le plan de symétrie central, le centre de ladite partie centrale de formage de rainures (1A) étant choisi comme étant ladite partie longitudinale prédéterminée (C1) dudit premier rouleau (1), comme par exemple au moyen d'une réduction du rayon d'une saillie de formage annulaire située au centre (3).

3. Système selon la revendication 1, caractérisé en ce que deux (C2) parmi lesdites parties longitudinales prédéterminées (C1, C2) dudit premier rouleau (1) sont choisies pour être chacune entre l'une desdites parties de roulage de bordure (1B) et une saillie adjacente (2') de ladite pluralité de saillies de formage annulaires (2) dudit premier rouleau (1).

4. Système selon la revendication 1, caractérisé en ce que lesdits moyens de retenue (9) ont la forme de deux brides, chaque bride étant montée sur une extrémité longitudinale dudit premier rouleau (1).

5. Système selon la revendication 1, caractérisé en ce que lesdits moyens de retenue (9) ont la forme de deux brides, chaque bride étant montée sur une extrémité longitudinale dudit second rouleau (8).

6. Système selon la revendication 1, caractérisé en ce que lesdites saillies de formage annulaires (2) de ladite partie centrale de formage de rainures (1A) sont disposées avec un pas constant.

7. Système selon la revendication 1, caractérisé en ce que ladite pluralité de saillies de formage annulaires (2) ont en moyenne un pas de 0,55 mm, une hauteur de 0,16 mm, et un angle d'inclinaison de 10°.

FIG.1A

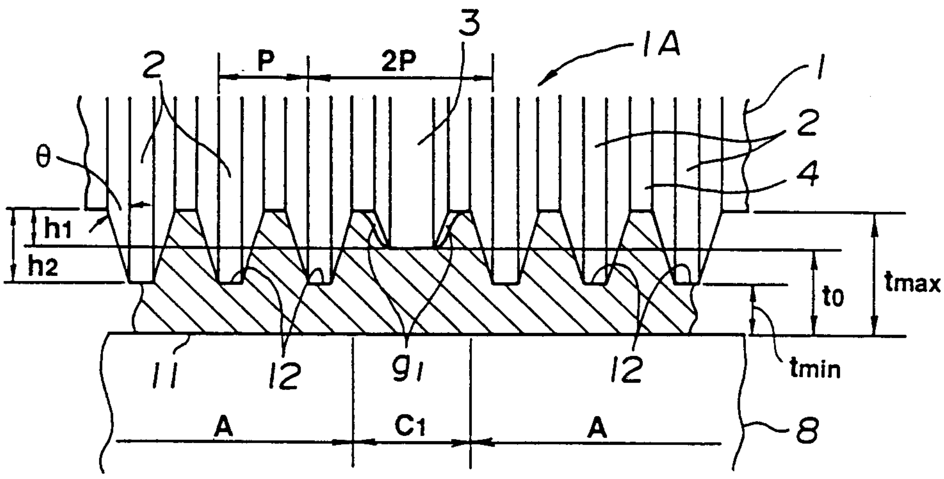

FIG.1B

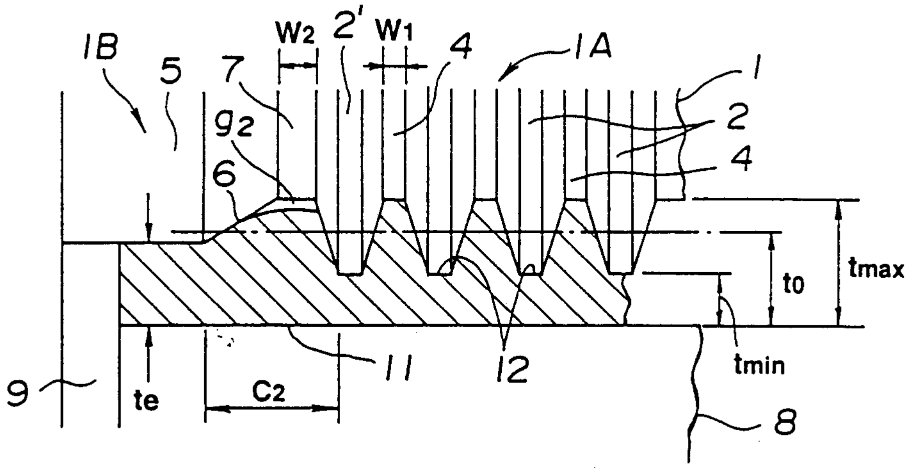

FIG.1C

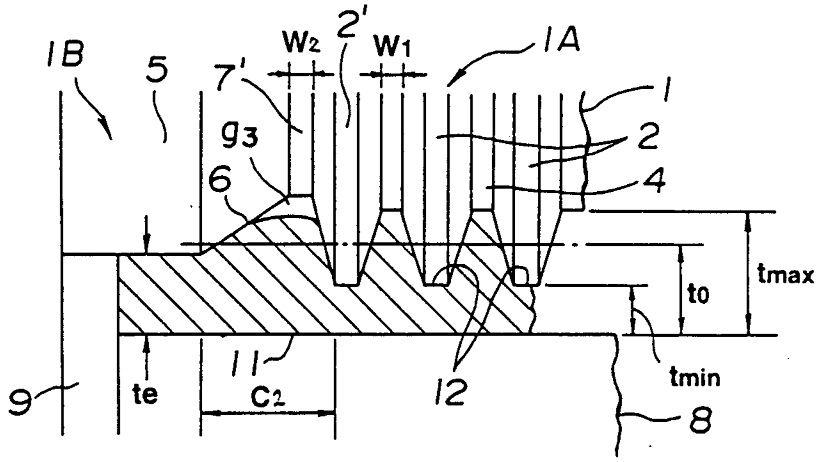

FIG.2A

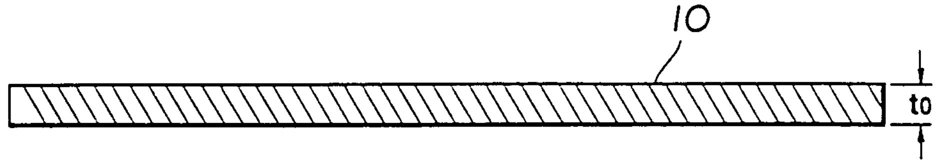

FIG.2B

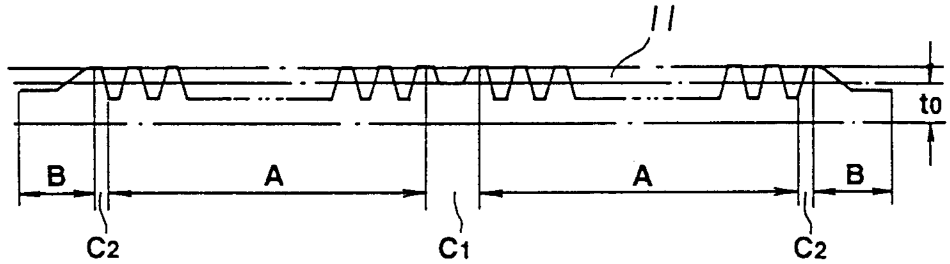

FIG.4A

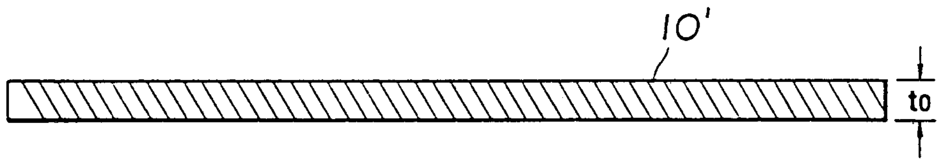

FIG.4B

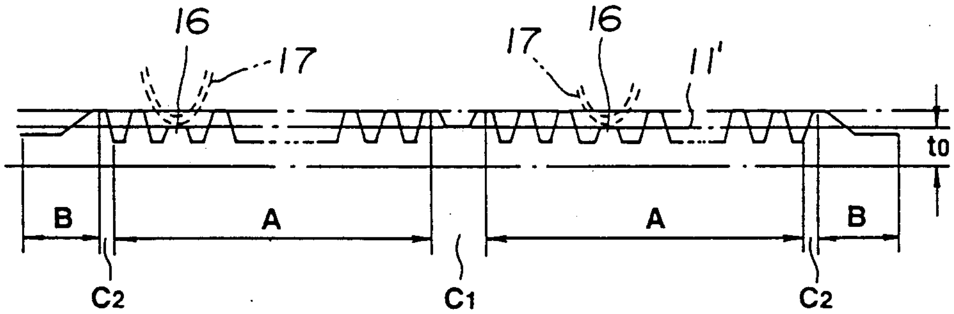

FIG.3 A

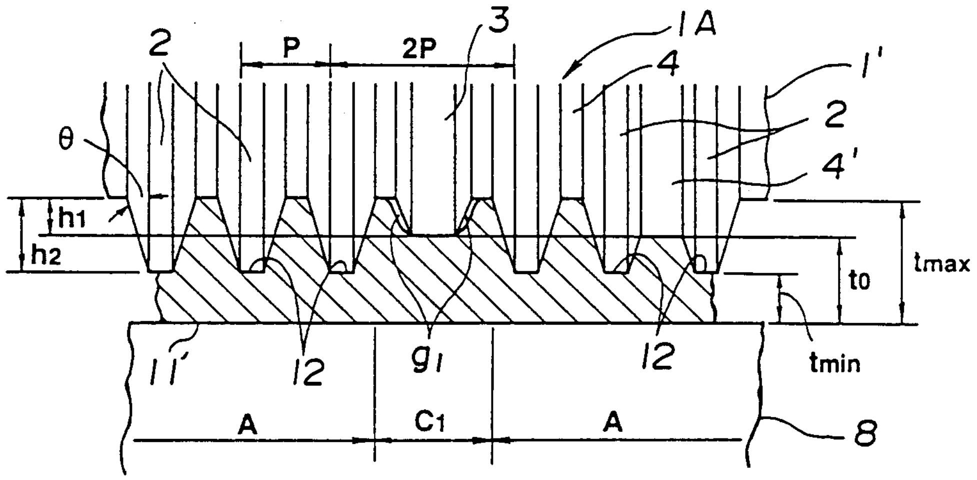

FIG.3 B

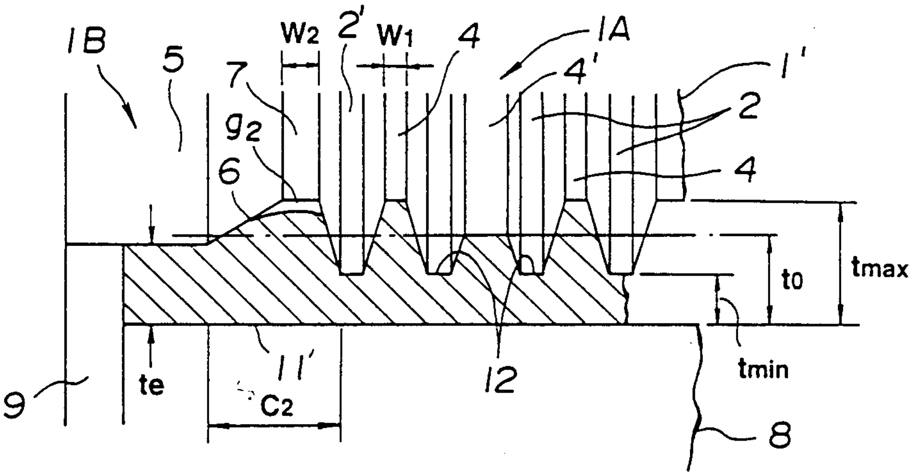

FIG.3 C

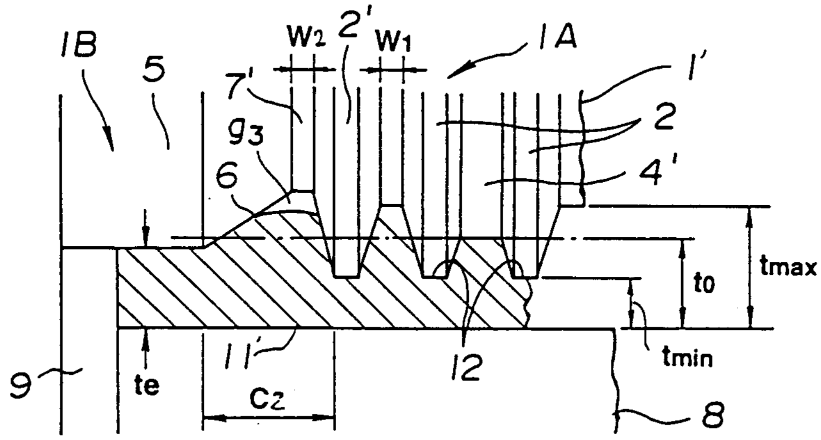

FIG.5A

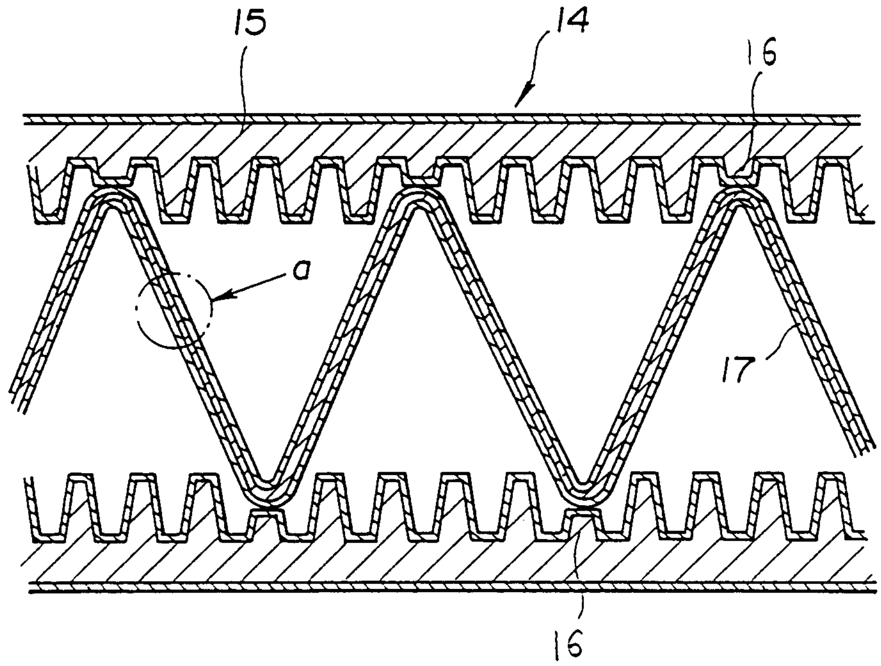

FIG.5B

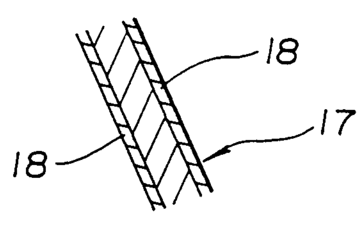

FIG.6A

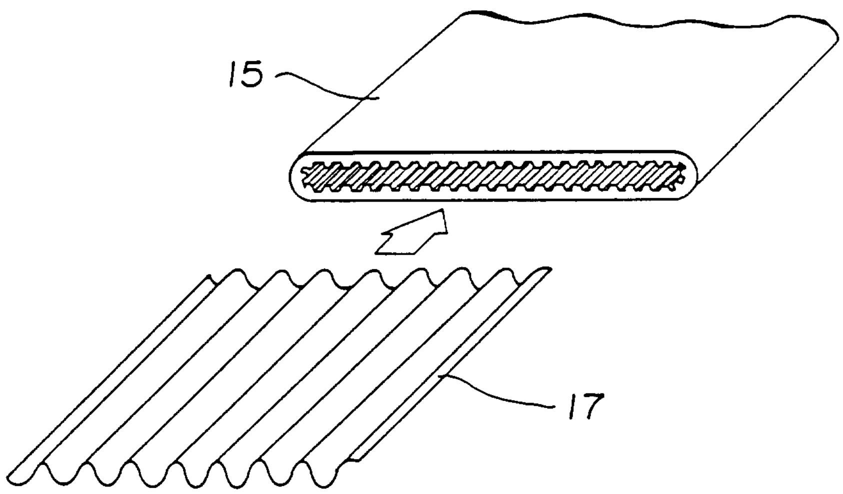

FIG.6B

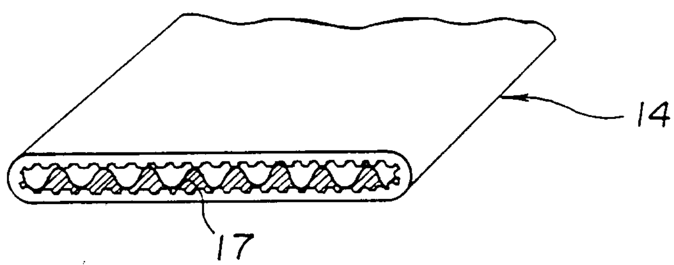

FIG.7

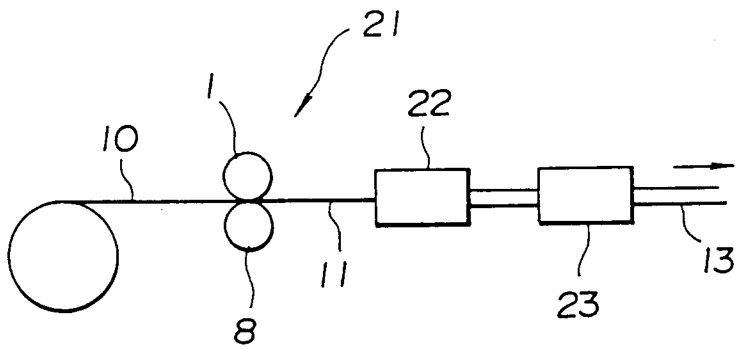

FIG.8A
(PRIOR ART)

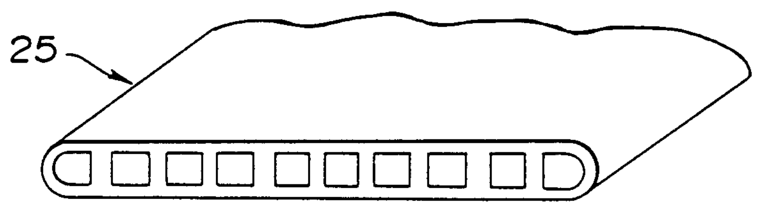

FIG.8B
(PRIOR ART)

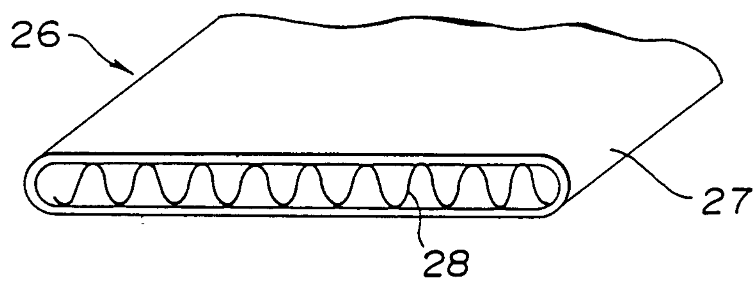

FIG.8C
(PRIOR ART)