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(54) **APPARATUS AND METHOD FOR BENDING OF SHEETS FOR THE MANUFACTURE OF TUBES**

VORRICHTUNG UND VERFAHREN ZUM BIEGEN VON BLECHEN ZUR HERSTELLUNG VON ROHREN

APPAREIL ET PROCÉDÉ POUR LE CINTRAGE DE FEUILLES POUR LA FABRICATION DE TUBES

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EP 2 125 261 B1

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Description

OBJECT OF THE INVENTION

[0001] The present invention relates to a machine and the relative procedure for bending metal sheets in a substantially cylindrical way, called ferrules, with high precision in terms of the cylindricity. A machine according to the preamble of claim 1 is e.g. known from JP-A-60145223.

STATE OF THE ART

[0002] Machines are known for bending metal sheets in a substantially cylindrical way, called ferrules, using two-roller benders. Such benders consist of a mechanical forming tool, also called forming roller, preferably made of metal and a second urethane roller which is able to deform the metal sheet through pressure against the forming tool. In the known machines, the ends of the forming tool are supported and clamped at one end with a fixed end made with bearings and at the other end with devices, such as pivotinghinge supports, which, in any case, support the forming tool in just one point or in a very reduced area.

[0003] Said known machines have the drawback that the forming tool is subjected to pressure due to the roller levelling process which bends said forming tool in a non-symmetrical way with quite high bending values. Such bending of the forming tool is necessarily taken over in an unfavourable way by the ferrule, resulting in tubes that are not perfectly cylindrical.

[0004] The machines available in the marketplace have the further drawback of having the forming tool which can bend the metal sheets according to one sole radius, hence having to replace the forming tool in order to vary the bending radius of the metal sheet. Such a replacement requirement of the forming tool creates numerous drawbacks such as machine downtime and risks of breakage or damage of the forming tool during replacement.

DISCLOSURE OF THE INVENTION

[0005] The present invention favourably solves the drawbacks of the machines of the known art as it can obtain ferrules with a higher degree of cylindricity than those made by the machines available in the marketplace and, also, bend metal sheets so as to obtain ferrules of a variable radius without replacing the forming tool, also processing materials of different thicknesses and resistances.

[0006] Said objects and advantages are all obtained by the machine and its procedure object of the present invention, which is characterised according to the following claims.

[0007] This and other features will be clear from the following description of some embodiments shown, by way of example only and by way of a non-limitative example in the attached drawing tables, wherein:

Figure 1 shows a perspective view of the machine assembly for manufacturing tubes with the bending plane with an elastomeric roller and a forming tool, object of the present invention;

- Figure 2 shows a perspective view of the details of the rigid metal structure placed above and in parallel to the forming tool;
- Figure 3 shows a perspective view of the details of the fixed end devices suitable for locking both the ends of the forming tool in place;
- Figure 4 shows a front view of the forming tool elements.
- Figure 5 shows a static view of the first stage of the procedure that the machine object of the present invention, carries out.

Figure 1 shows a perspective view of the assembly of the machine for manufacturing tubes comprising an elastomeric roller (1) positioned in parallel to the forming tool (2). The metal sheet is positioned between said roller 1 and the tool 2 for the forming process of the ferrules.

Figure 2 shows the details of the rigid metal structure (3), preferably plate-shaped and positioned in a parallel position above the forming tool (2), fixed at the sides of the machine with special devices. Said metal structure 3 is suitable to prevent or limit the flexure of said tool 2 generated by the pressure of the roller 1 against the lamina and the tool 2. The absence or limitation of flexure of said tool 2 due to the metal structure 3 allows to obtain ferrules with a high degree of cylindricity favourably.

Figure 3 shows the details of the fixed end devices (4.1 and 4.2), preferably jaws, suitable for locking each end (5.1 and 5.2) of the forming tool 2 in a large area, further limiting the flexure generated by the elastomeric roller 1 which presses the lamina and the forming tool 2 during the lamina bending stage, compared to machines readily available in the marketplace. The device 4.1 is closed during the lamina bending stage, hence locking the end 5.1 of the tool 2 in place, opening to the conclusion of the process, allowing the ferrule to be extracted so as to permit subsequent processing cycles. The combination of said devices 4.1 and 4.2 with the metal structure 3 induces greater linearity of said tool 2 during the forming procedure of the ferrules, obtaining a higher degree of cylindricity compared to that of the machines available in the marketplace.

Figure 4 shows the forming tool 2 comprising a forming roller (6) incorporated in a shell (7) and auxiliary forming rollers (8) positioned symmetrically on the circumference of the forming roller 6 allowing the fer-

rule shaped by the elastomeric roller (1) to be reopened. Said forming tool 2, shown in Figure 4, is suitable for bending metal sheets of various radii based on the auxiliary roller 8 engaged with the bending: the closest auxiliary rollers 8 to the centre of the forming roller 6 realize ferrules of a larger radius compared to the ferrules realized engaging with the auxiliary rollers 8 progressively further with said central position of the forming roller 6.

[0008] Various embodiments of the machine for manufacturing tubes can change, in particular in relation to the arrangement and co-presence of all the comprising elements, without departing from the scope of the present invention as defined by the appended claims.

[0009] The procedures that the machine object of the present invention, carries out are as follows.

[0010] In the first stage of the procedure, the bending of the metal sheet is carried out by the first 180°.

[0011] During said stage, the forming tool 2 is rotated in relation to the central axis of the forming roller 6. With said rotation, one of the auxiliary forming rollers (8) is engaged with the bending of the metal sheet, i.e., the forming roller 6, based on the bending radius of the metal sheet to be realized according to the predetermined processing programme. Said first stage is depicted statically in Figure 5, showing the forming tool 2, comprising a forming roller (6) incorporated in a shell (7) and auxiliary forming rollers (8), rotated to engage with an auxiliary roller (8) in the bending of the metal sheet.

[0012] In a second stage, the metal sheet to be bent is hence subjected to bending as a consequence of the pressure exerted by the elastomeric roller 1 against the rotated forming tool 2. The bending process is interrupted once the first 180° of metal sheet bending have been reached. The bending of the metal sheet through a further 180° takes place in a third stage, rotating the forming tool 2, in relation to the central axis of the forming roller 6, in a symmetrically opposite position to that taken on during the first stage of the procedure. In the fourth stage of the procedure, the bending of the metal sheet is carried out by a further 180° in the same way as the procedure described for the aforementioned stage two, obtaining a complete ferrule of the required radius.

[0013] The manufacturing machine object of the present invention also carries out a bending procedure of at least the first and last centimetre of the metal sheet to be bent, with no auxiliary roller (8) or forming tool (6) intervening in the bending of said portion of said metal sheet.

[0014] The bending procedure for said portions of the metal sheet, carried out by said machine, is carried out through the control, preferably electronic, of the amount of pressure exerted on the metal sheet and on the tool 2 by the elastomeric roller (1) according to the mechanical resistance of the metal sheet to be bent and the size of the bending radius to be realized.

Claims

1. Machine for manufacturing tubes of the type comprising a calendering apparatus that bends the metal sheet provided with an elastomeric roller (1) located in parallel to the forming tool (2), comprising a rigid metal structure (3) disposed in parallel to the forming tool (2) suitable to limit the flexure of said forming tool (2), and comprising embedding devices (4.1 and 4.2) suitable to firmly lock both the ends (5.1 and 5.2) of the forming tool (2) in place **characterised in that** one embedding device (4.1) comprises two jaws.

2. Machine according to claim 1, **characterised in that** the forming tool (2) comprises:

   - a forming roller (6) incorporated in a shell (7);
   - auxiliary forming rollers (8) placed symmetrically on the circumference of the forming roller (6).

3. Bending procedure of the metal sheet using the machine according to claims 1 or 2, **characterised in that** it comprises the following stages:

   1 the rotation of the forming tool (2) in relation to the central axis of the forming roller (6) to engage one of the auxiliary forming rollers (8) or the forming roller (6) according to the predetermined processing programme;
   2 bending of the metal sheet up to essentially 180°;
   3 rotation of the forming tool (2) in relation to the central axis of the forming roller (6) in a diametrically opposite position to that used for stage 1;
   4 bending of the metal sheet up to essentially 180°.

4. Bending procedure according to claim 3, **characterised in that** for at least the first and /or the last centimetre of the metal sheet the stages from 1 to 4 are substituted by the following stage: pressing of the elastomeric roller (1) against the forming tool (2) according to a predetermined variable programme

Patentansprüche

1. Maschine zur herstellung von röhren vom typ mit einem kalandriervorrichtung dass das blech mit einem elastomeren rolle vorgesehen kurven (1) parallel zu dem formwerkzeug (2) befindet, mit einer starren struktur aus metall (3) angeordnet parallel zum formwerkzeug (2) geeignet, um die biegung der grenze sagte formwerkzeug (2) einbettung geräte (4,1 und 4,2) geeignet und umfassend zu fest verriegeln beiden enden (5,1 und 5,2) des formwerkzeugs (2) in

kraft, daß man **dadurch** die einbettung gerät (4.1) besteht aus zwei backen;

2. Maschine nach anspruch 1 **dadurch gekennzeichnet, dass** das formwerkzeug (2) aufweist:

- eine formrolle (6) eingebaut in einer shell (7);
- hilfs-formrollen (8) symmetrisch am umfang der formrolle (6) gelegt.

3. Biegen verfahren des blechs mit der maschine nach den ansprüchen 1 oder 2, **dadurch gekennzeichnet, dass** sie umfasst die folgenden phasen:

1 die rotation der formwerkzeug (2) in bezug auf die mittelachse des formrolle (6) zu einem der hilfs-formrollen (8) oder die billdung rolle (6) entsprechend dem vorgegebenen verarbeitung programm zu beteiligen;
2 biegen des blechs bis im wesentlichen 180°;
3 umdrehung des formwerkzeugs (2) in bezug auf die mittelachse des formrolle (6) in einem diametral entgegengesetzten standpunkt, dass für die stufe 1 verwendet werden;
4 biegen des blechs bis zu wesentlichen 180°.

4. Biegevorganges nach anspruch 3 **dadurch gekennzeichnet, dass** zumindest für die erste und / oder die letzten zentimeter des bleches die stufen 1 bis 4 durch folgende stufe substituiert sind **gekennzeichnet: durch** drücken der elastomeren walze (1) gegen die bildung werkzeug (2) nach einem vorgegebenen programm variable

Revendications

1. Machine de fabrication de tubes du type comprenant un appareil de calandrage qui plie la plaque métallique fournie avec un rouleau en élastomère (1) situé en parallèle à l'outil de formage (2), comprenant une structure rigide en métal (3) disposés en parallèle à l'outil de formage (2) approprié pour limiter la flexion de ladite outil de formage (2) Dispositifs enrobage (4,1 et 4,2) approprié et comprenant pour verrouiller fermement les deux extrémités (5,1 et 5,2) de l'outil de formage (2) en place **caractérisé en ce que** l'intégration une dispositif (4,1) comprend deux mâchoires;

2. Machine selon la revendication 1, **caractérisé en ce que** l'outil de formage (2) comprend:

- Un rouleau de formage (6) incorporé dans un shell (7);
- Auxiliaires rouleaux de formage (8) placés symétriquement sur la circonférence du rouleau (6) formant.

3. Procédure de pliage de la tôle à l'aide de la machine selon les revendications 1 ou 2, **caractérisé en ce qu'**il comprend les étapes suivantes:

1 la rotation de l'outil de formage (2) par rapport à l'axe central du rouleau (6) formant de s'engager l'un des galets auxiliaires formant (8) ou le rouleau de formage (6) selon le programme de traitement prédéterminé;
2 flexion de la tôle jusqu'à 180° en substance;
3 rotation de l'outil de formage (2) par rapport à l'àxe central du rouleau (6) formant dans une position diamétralement oppose à celle utilisée pour l'étape 1;
4 Flexion de la tôle jusqu'à 180° en substance.

4. Procédure de pliage selon la revendication 3, **caractérisé en ce que** au moins la première et / ou le dernier centimètre de la tôle les étapes 1 à 4 sont remplacés par l'étape suivante: l'appui du rouleau en élastomère (1) contre la formation outil (2) selon un programme prédéterminé variable

FIG. 1

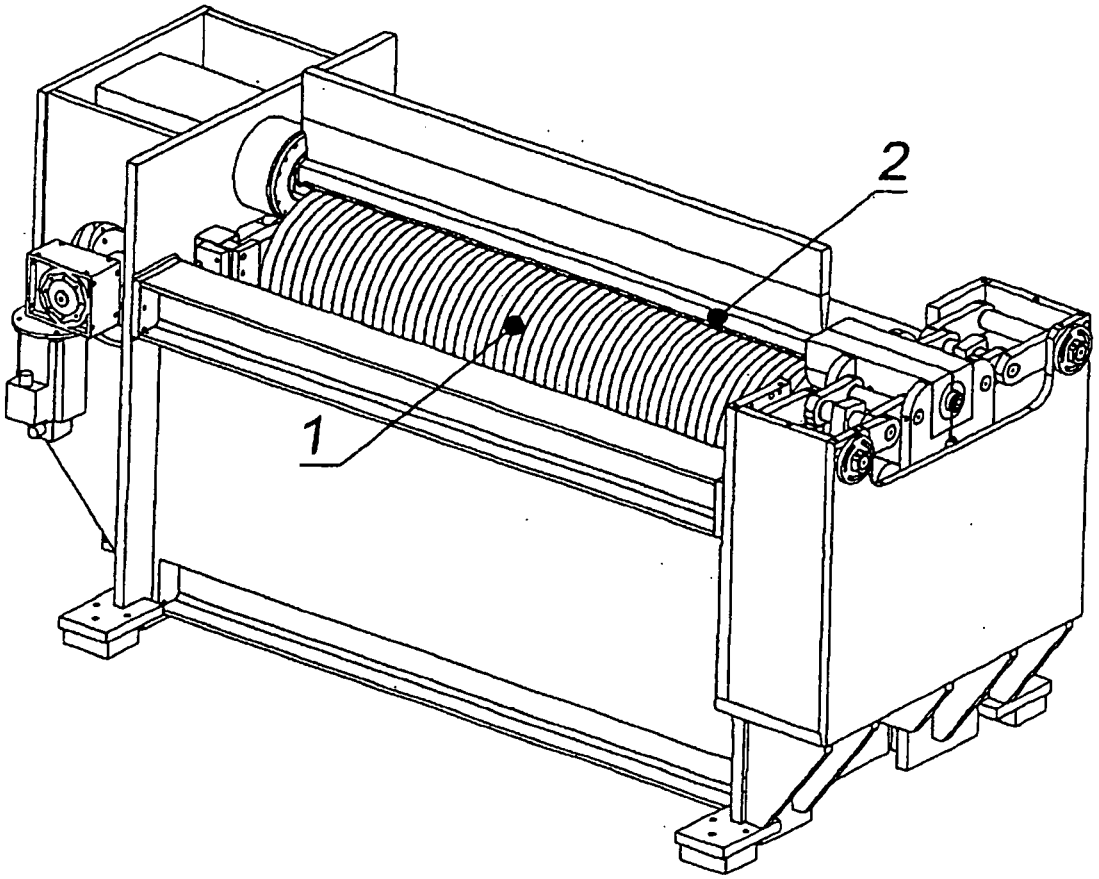


FIG.2

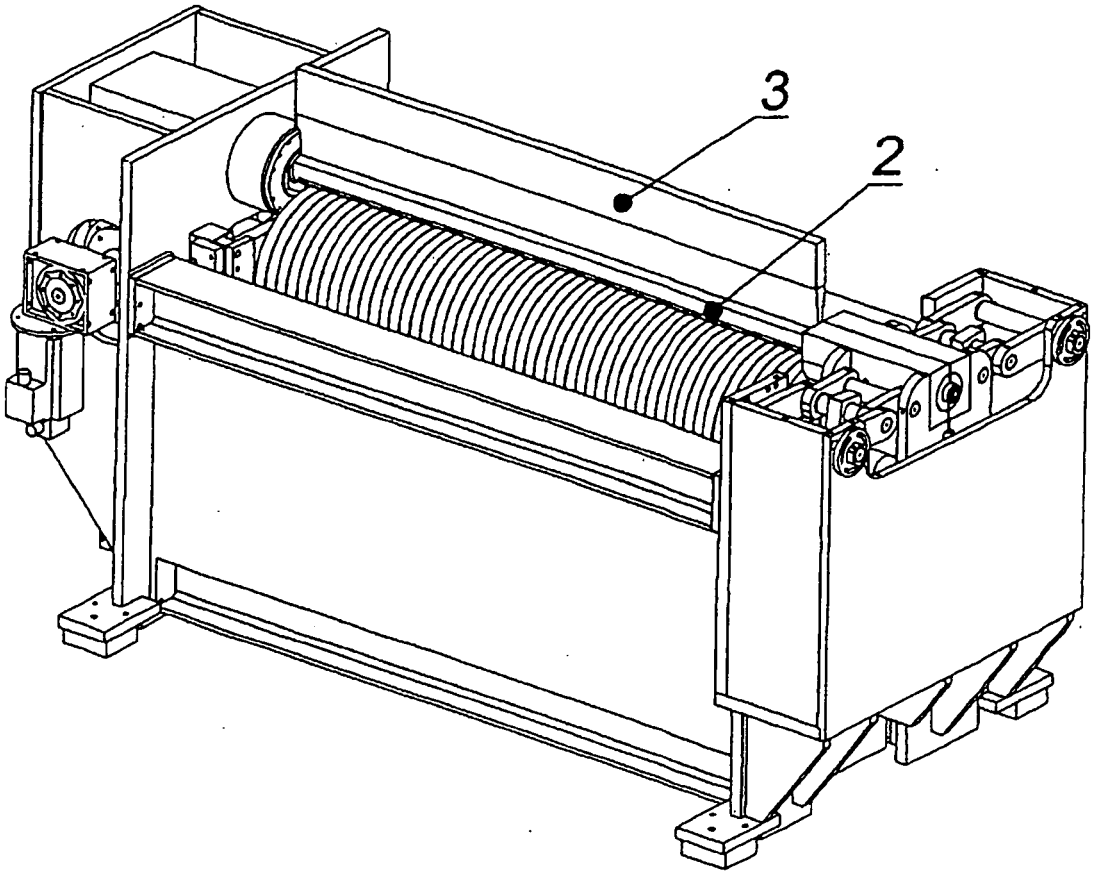


FIG.3

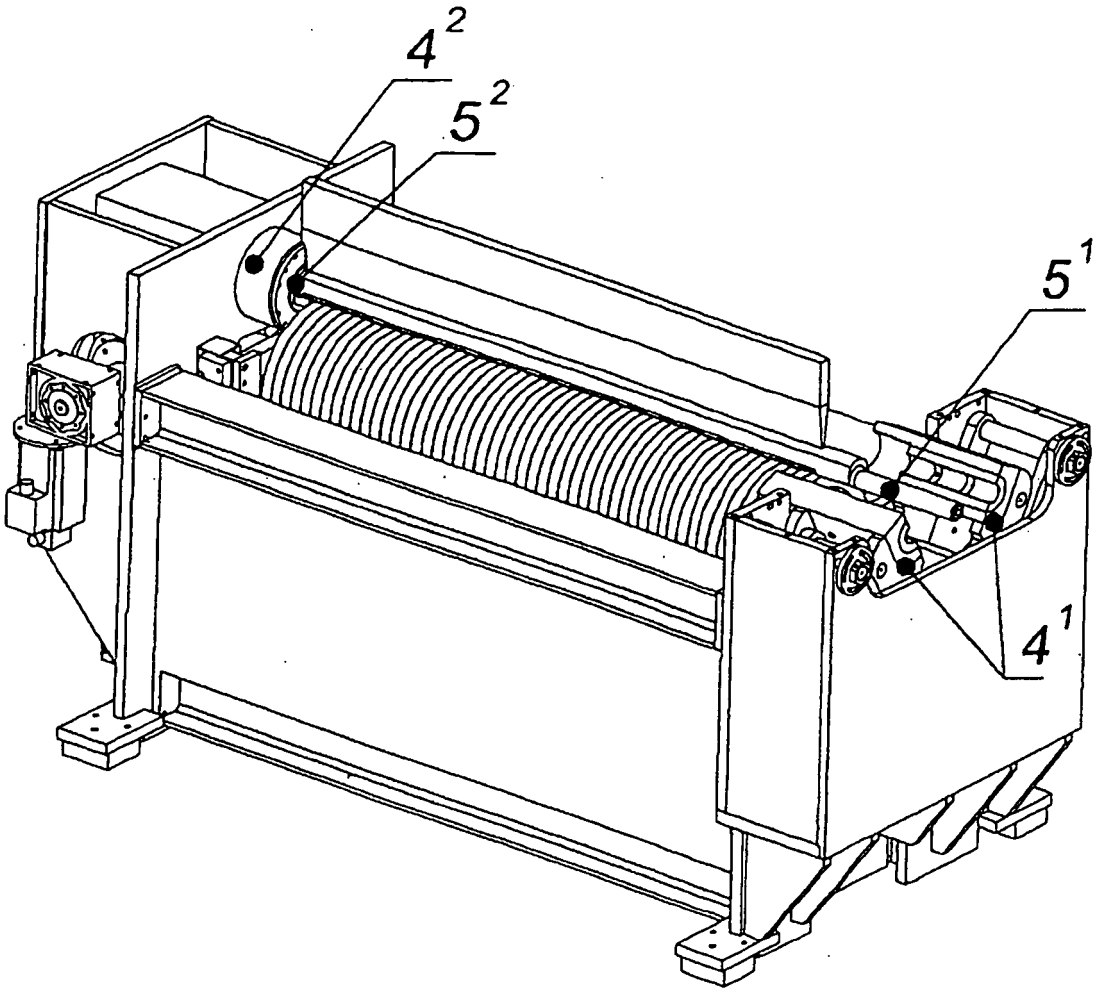


FIG. 4

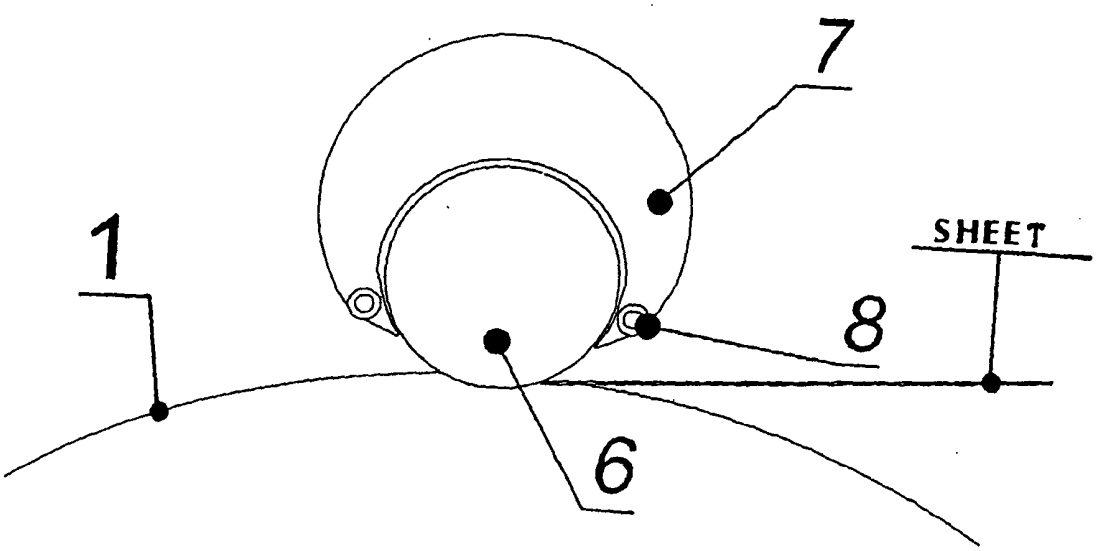
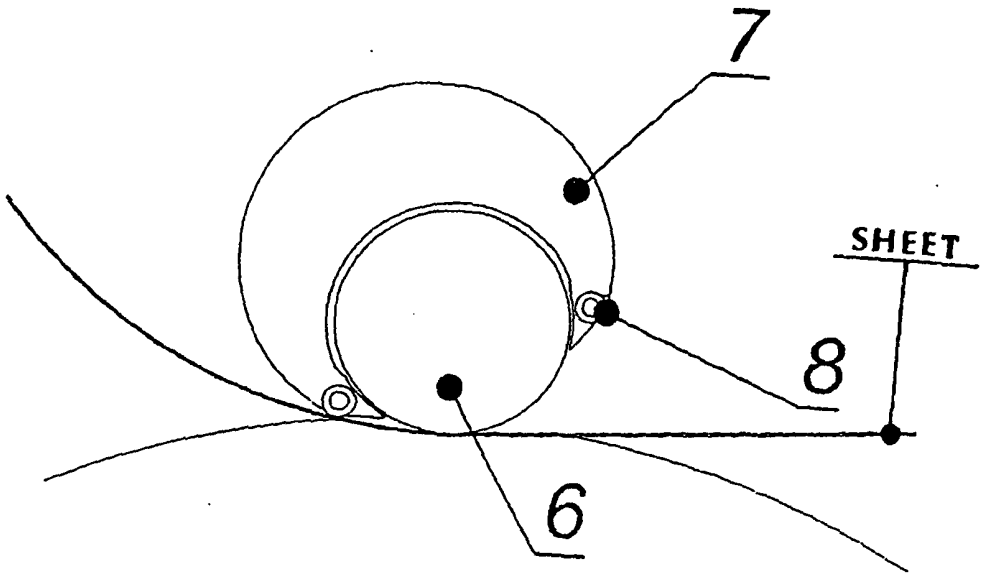


FIG. 5



REFERENCES CITED IN THE DESCRIPTION

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