June 13, 1972 K. KLOTZBACH ET AL 3,669,808

ROLLING APPARATUS FOR THE ROLLING TOGETHER OF CURVED GLASS SHEETS WITH INTERPOSED PLASTICS SHEETS TO FORM A LAMINATE

Filed July 21, 1970 4 Sheets-Sheet 1

Fig. 1

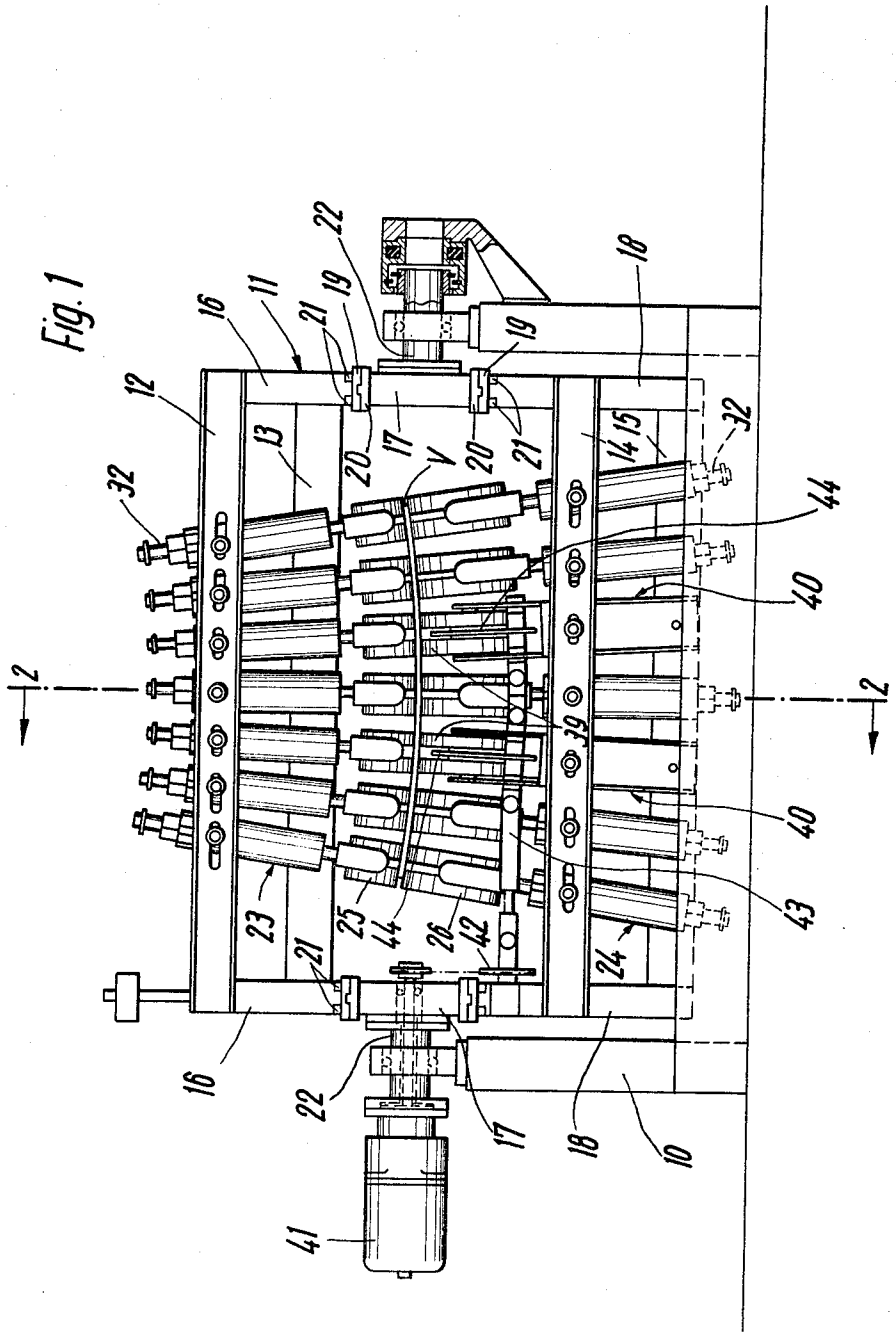

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Fig. 2

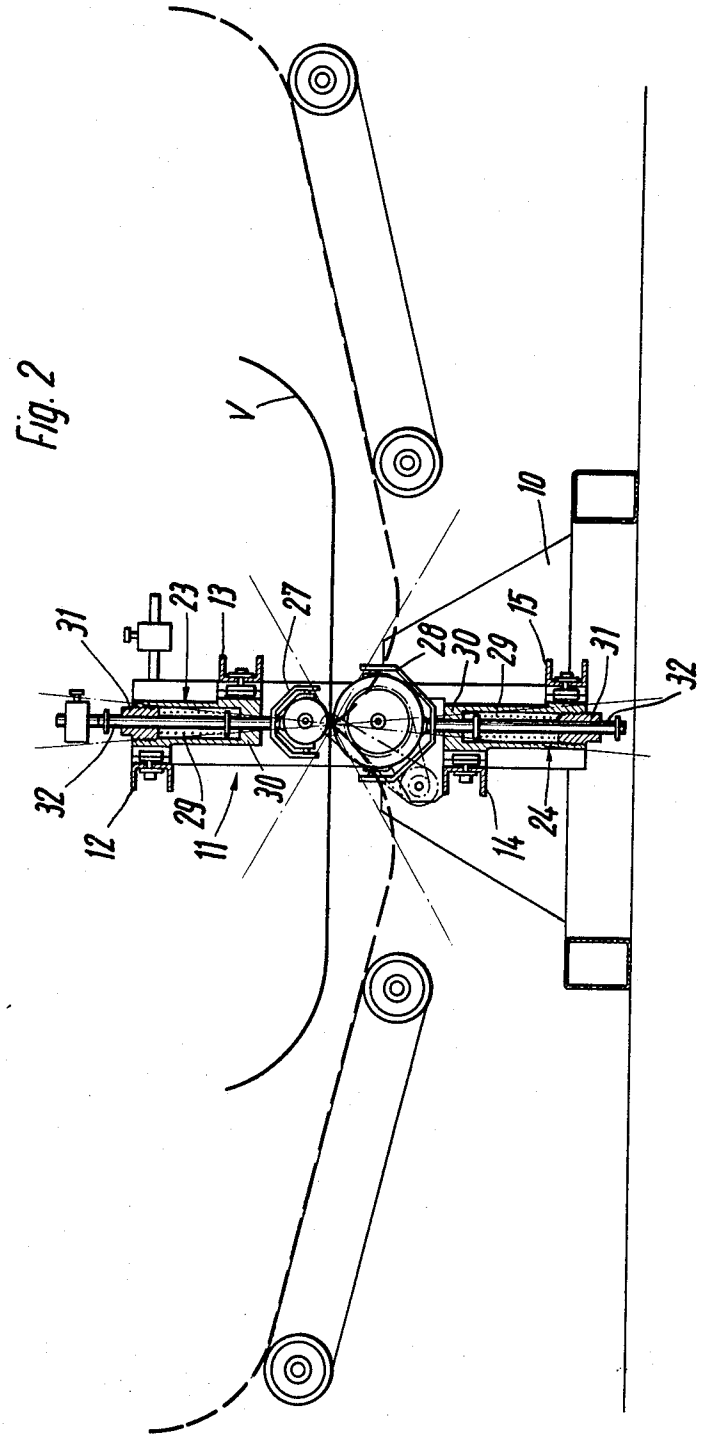

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Fig.3

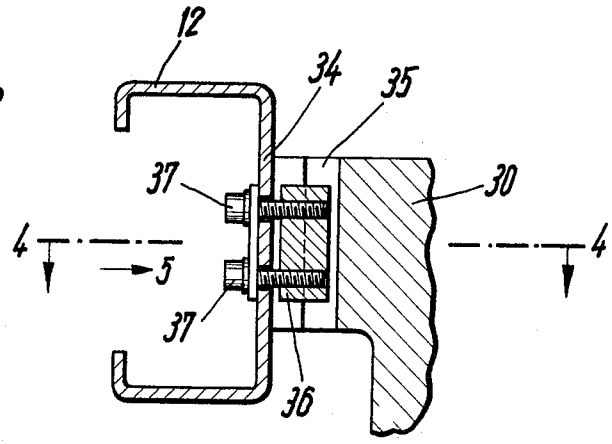

Fig.4

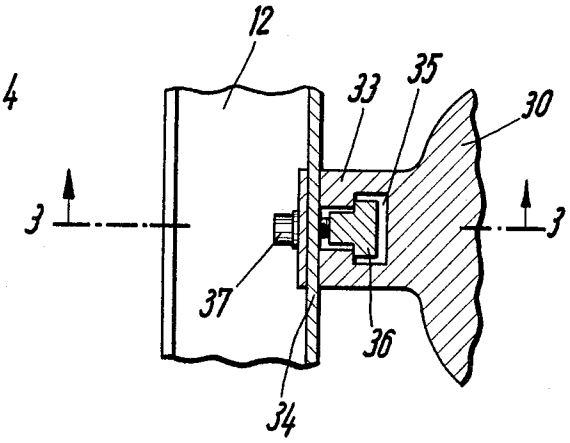

Fig.5

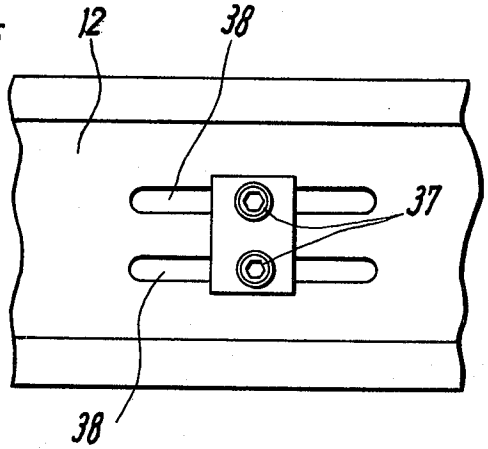

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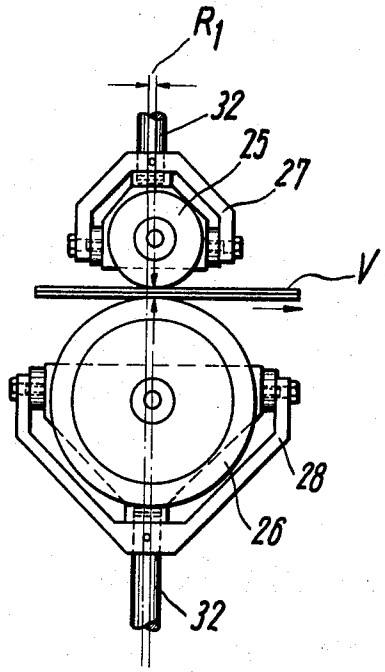
Fig. 6



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ROLLING APPARATUS FOR THE ROLLING TOGETHER OF CURVED GLASS SHEETS WITH INTERPOSED PLASTICS SHEETS TO FORM A LAMINATE

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U.S. Cl. 156—582 15 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for rolling together superimposed curved sheets to form a curved laminate comprises a pivoted frame in which are mounted two opposed groups of pressure roller units. Each unit comprises pressure rollers carried on a guide rod slidably and rotatably mounted in a hollow housing which contains a spring biassing the guide rod to one end of the housing. The housings of the pressure roller units are individually adjustable in position on the housing so that the apparatus can be set so that the combined roller gap defined between the opposed groups of pressure rollers, has any desired curvature.

The invention relates to a rolling apparatus for rolling together curved superimposed sheets to form a curved laminate, for example for rolling together spherically curved glass sheets with interposed plastics sheets to form a curved piece of safety glass, said apparatus being of the kind provided with a pivoting frame, adapted to pivot around an axis which extends substantially perpendicularly to the rolling direction said frame having disposed therein a plurality of pressure rollers, thrust against each other by springs and adapted to act upon the upper and lower sheets of the laminate being formed.

In known rolling apparatus of the kind heretofore described, used for rolling together glass sheets with interposed plastic sheets, the pressure rollers acting from above on the surface of the upper glass sheet are disposed on rods which are longitudinally slidably supported in the pivoting frame and are prestressed in the direction towards the roll gap by means of two tension springs each. The pressure rollers which bear from below against the surface of the lower glass sheet are disposed on pivoting levers which are hinged on the pivoting frame. The pivoting levers are also prestressed by means of freely exposed tension springs in the direction towards the surface of the lower glass sheet. This kind of rolling apparatus is suitable only for rolling together of glass sheets with one particular curvature transversely to the rolling direction to form a laminate. A different pivoting frame, separately prepared, must be mounted in the rolling apparatus for sheets having a different curvature transversely to the rolling direction.

By contrast, the inventors propose to provide a rolling apparatus of the kind mentioned heretofore in which laminates of various different curvatures can be rolled without the need for exchanging the pivoting frame. The problem is solved by combining each pressure roller together with the components supporting same and the associated spring to form a pressure roller unit adapted for mounting on the pivoting frame independently of the other pressure roller units and being removable therefrom individually and that the pressure roller units are mounted on the pivoting frame so as to be adjustable transversely to the rolling direction for different curvatures of the laminate to be rolled. This procedure not only extends the field of application of the rolling apparatus to the processing of sheets of different curvatures but maintenance and repair can thus be rendered more simple and rapid since it is possible for complete pressure roller units to be kept in stock for rapid exchanging with any damaged pressure roller unit in the event of defects.

In a preferred embodiment the pivoting frame comprises two bar members, disposed substantially vertically and adapted to support the pivoting pins of the pivoting frame, and two pairs of horizontally extending cross members each said pair being adapted to join the bar members above the upper and below the lower sheets of the laminate respectively, the pressure roller units with the pressure rollers acting on the upper sheet being mounted on the upper cross member and the pressure roller units with the pressure rollers acting upon the lower sheet being mounted on the lower cross member. The mounting of each pressure unit on two cross members offers the advantage that the units reliably retain their preset position during the rolling operation even if high thrust forces occur, so that flexure of the cross members is kept to very small amounts.

In an advantageous further improvement each bar member of the pivoting frame comprises three detachably joined bar parts, the cross members joining the bar members connecting corresponding outer parts of the two bar members while the middle part of each bar member supports one of the pivoting pins of the pivoting frame. To this end it is advisable to provide at abutting ends of adjacent parts of each bar endplates which bear upon each other in pairs when the bar parts are joined and the abutting endplates being screw mounted to each other. This construction permits the exchange of a complete pivoting frame by lifting the frame from the stand, and also permits parts of the pivoting frame to be removed, the pivoting pins remaining in the bearings of the stand.

To ensure reliable alignment of the bar member parts relative to each other tongues and grooves are provided in the endplates, at least transversely to the rolling direction.

Alignment of the bar parts in the rolling direction can be ensured in simple manner if the abutment endplates of two adjacent bar parts always have the same length in the rolling direction, the endplates being mounted on the bar parts so that adjacent bar parts are in alignment if abutting endplate edges, defining the endplates in the rolling direction, are in alignment.

In one embodiment the pressure roller units have an elongated housing in which a guide rod one end of which supports the pressure roller, is supported so as to be slidable along its longitudinal axis and to be rotatable about said axis. In this embodiment a compression spring is disposed in the housing, one end of said compression spring bearing upon the housing and the other end acting on the guide rod, to prestress the said guide rod in the direction of the pressure roller. Such a pressure roller unit represents a very compact component, the use of a compression spring, encapsulated in a housing, enabling high rolling pressures to be produced without the construction becoming excessively heavy. Encapsulation of the spring also increases the safety since no spring parts can be thrown in the event of spring fracture.

In the preferred embodiment of the invention the guide rod for supporting the pressure roller extends through the housing of the pressure roller unit so that its two ends extend from the housing and the compression spring on the housing end disposed opposite to the pressure roller bears upon a stop which is adjustable along the longitudinal axis of the housing. To this end, the stop may be formed by a closure, screw mounted in the housing and

through which closure the free end of the guide rod extends. In this way it is possible for the prestress of the spring to be adjusted to a desired amount prior to assembly in the pivoting frame.

In the preferred embodiment the housing of each pressure roller unit is provided with two extensions having abutment surfaces for bearing upon the cross members of the pivoting frame, grooves of T-cross section being provided in the extensions and at least one block of T-shaped cross section, detachably mounted on the associated cross member being adapted to engage into each of the aforementioned slots. To this end it is advisable that the T-shaped block be mounted on the cross member by at least one but preferably two screws traversing apertures in the cross member. This construction enables each pressure roller unit—after slackening the screws which mount the block on the cross members—to be displaced along the longitudinal axis of the pressure unit, in the pivoting frame.

In order to facilitate displacement of the units in the horizontal direction and pivoting of the pressure roller units so that they can be adjusted to different curvatures of sheets transversely to the rolling direction, a further feature provides that at least part of the ports provided in the cross members for mounting the blocks, are shaped in the form of substantially horizontally extending slots.

The feed of the laminate through the roll gap is provided by driven feed rollers which, in the preferred embodiment of the invention, are combined with components for retaining them on the pivoting frame to form feed roller units which can be exchanged for the pressure roller units. The aforementioned feed roller units may be mounted on the cross members of the pivoting frame in the same manner as the pressure roller units by means of T-shaped blocks which engage into slots whose cross section is of T-shape. Accordingly, the feed roller units in the same way as the pressure roller unit can be simply and rapidly adjusted to sheets of different sheet curvature and can be equally readily installed and removed, and are readily exchangeable for pressure roller units.

To ensure that during the rolling operation the pressure rollers are orientated accurately in the rolling direction it is possible for each pressure roller unit to be so constructed that the extension of the longitudinal centre axis of the guide rod is disposed in front of the axis of rotation of the associated pressure roller as seen in the rolling direction so that during the rolling of a laminate the pressure roller adjusts itself in self-aligning manner around the longitudinal centre axis of the guide rod in the rolling direction.

An embodiment of the invention will now be described with reference to the accompanying drawings wherein:

FIG. 1 is a front view of a rolling apparatus according to the invevntion for the rolling together of glass sheets with interposed plastics sheets to form laminate safety glass;

FIG. 2 is a section along the line 2—2 of FIG. 1;

FIG. 3 is a partial section showing the method of mounting the pressure roller unit on one of the cross members of the pivoting frame;

FIG. 4 is a section along the line 4—4 of FIG. 3;

FIG. 5 is a partial view seen in the direction of the arrow 5 of FIG. 3, and

FIG. 6 is a side view of two pressure rollers cooperating during the process of rolling the laminate.

Referring to FIGS. 1 and 2 a rolling apparatus for rolling together glass sheets with interposed plastics sheets to form a laminate comprises a stand **10** in which a frame **11** is mounted for pivoting about a horizontal axis. The frame **11** comprises two bar members, joined by cross members **12, 13, 14** and **15**. Each bar member comprises three detachably joined bar parts **16, 17** and **18**. The cross members **12, 13**, and **14, 15**, constructed of open sections, are mounted on the bar parts **16** or **18** respectively, for example by welding or by means of screws. The bar parts **16, 17** and **18** comprise hollow sections, for example rectangular tubes, whose abutting ends are provided with welded endplates **19** and **20**. The endplates of the outer bar parts **16** and **18** are each provided with a longitudinal groove, extending in the rolling direction and into which a tongue on one of the endplates **20** of the middle bar part **17** is adapted to engage. Each pair of endplates **19** and **20** is held together by means of four screw bolts **21**. The pivoting frame **11** is supported in the stand **10** on short pivoting pins **22** which are disposed on the middle bar parts **17**. An upper group and a lower group of pressure roller units **23** and **24** respectively, opposing ends of which support upper and lower pressure rollers **25** and **26** respectively, are disposed in the pivoting frame. Each of the upper and lower pressure roller units comprises a pair of pressure rollers **25** or **26** respectively which are supported in a thrust bracket **27** or **28** respectively which are thrust towards a corresponding pair of pressure rollers of the other group by a compression spring **29**. Each compression spring **29** is disposed in a separate spring housing **30** and one end of said spring bears on a housing closure **31** while the other end acts on an abutment on a guide rod **32**, extending through the housing and being guided therein for movement along its longitudinal axis and for rotation about said axis. The thrust bracket **27** or **28** respectively of the thrust rollers **25** or **26** respectively is mounted on the inward facing ends of the guide rod **32**. The other pressure roller units **23** and the lower pressure roller units **24** are mounted on the cross members **12, 13**, or **14, 15** respectively so as to be adjustable along their longitudinal axes.

The longitudinally adjustable manner of mounting a pressure roller unit **23** on the cross member **12** is illustrated in FIGS. 3 and 4. The pressure roller units **23** are joined to the cross member **13** and the pressure roller units **24** are joined to the cross members **14** and **15** in identical manner. The substantially cylindrical spring housings **30** are provided at their ends with two projections **33** having abutment surfaces **34**. One groove or slot **35** of T-shaped cross section and extending longitudinally is milled into each of the projections **33**. A block **36**, also of T-shaped cross section and adapted for screw mounting through the open end of the groove **35** to the cross member **12** engages in the aforementioned groove or slot. To this end, the cross member **12** is provided with apertures **38** through which two Allen screws **37** may be screwed to engage in tapped holes of the groove block **36**. When the screws **37** are tightened, the groove block is moved towards the cross member **12** and its hammer-shaped head stresses the projection **33** of the spring housing **30** against the cross member **12**. A frictional joint is thus produced between the cross member **12** and the abutment surface **34** of the projection **35**. The screws **37** are slackened to enable the pressure roller unit to be displaced. Since such action is accompanied by releasing of the frictional joint between the abutment surface **34** and the cross member **12** it is possible for the pressure roller unit to be displaced in the direction of the T-section groove. It will be evident that to this end it will also be necessary to release the frictional joint between the pressure roller unit and the second cross member **13**.

In order to enable the pressure rollers **25** and **26** to be adjusted to laminates V, which are curved transversely to the rolling direction, it is necessary for the pressure roller units to be not only longitudinally displaceable but they must also be mounted in the pivoting frame so as to be displaceable or pivotable in the direction towards the cross member. To this end, the apertures **38** are constructed as elongated slots as disclosed by FIG. 5. When the screws **37** are slackened it is possible for a pressure roller unit **23** or **24** to be displaced not only in the direction of the T-shaped groove or slot **35** but also in the direction of the slots **38**. In this way facilities are provided for aligning the pressure roller unit so that the totality of the pressure rollers forms a curver roll gap which can be varied within wide limits and can be

adapted to different curvatures of the sheets. It is an essential feature in the setting up of the roll gap that the upper and lower pressure rollers **25** and **26** are disposed accurately vertically upon each other since only these conditions will ensure the uniform transmission of the spring pressure on the laminate which is to be rolled together.

The feed of the laminate V through the roll gap during the rolling operation is effected by feed rollers **39**. The aforementioned feed rollers together with the components retaining same are combined into feed roller units **40** which are exchangeable for the pressure rollers units **24**. FIG. 1 shows in exemplified form two lower pressure rollers units **24** replaced by feed roller units **40**. The feed roller units are mounted in the same way as the pressure roller units by T-shaped slots and blocks in slots of the cross members **14** and **15**. This ensures that the feed rollers may also be accurately adjusted to the cross sectional shape of a laminate V which is to be rolled together. The feed rollers are driven by an electric motor **41** which is mounted outside the frame on one of the pivoting pins **22** and whose drive shaft extends through the pivoting pin, which is made hollow for this purpose, into the interior of the pivoting frame. The rotary motion of the drive shaft of the electric motor is transmitted by a chain transmission **42** to a universal shaft **43** which drives chain sprockets disposed in the zone of the feed roller units **40**. Said chain sprockets form part of the chain transmission **44** connected to the feed rollers **39**. FIG. 6 shows to an enlarged scale an upper and lower pressure roller pair **25** or **26** respectively supported in thrust brackets **27** and **28**. Each thrust bracket **27** and **28** comprises of an inner bearing bracket engaging between the rollers of the roller pairs **25** or **26** respectively and an outer bracket or larger width, additionally supporting the inner bracket and being fixedly joined thereto. It can be clearly seen that the longitudinal central axes of the guide rods **32**, on which the thrust brackets **27** or **28** respectively are disposed, are displaced in front of the axes of rotation of the respective pressure rollers **25** or **26** by an amount R_1 in the rolling direction. By virtue of the castor action afforded by this feature the pressure rollers automatically adjust themselves in the rolling direction during the rolling operation.

We claim:

1. Rolling apparatus for rolling together curved superimposed sheets to form a curved laminate comprising means for passing in a rolling direction superimposed sheets having a curvature in a plane transverse to the rolling direction, a frame and means mounting said frame for pivoting about an axis substantially perpendicular to the rolling direction, a plurality of pressure roller units each comprising pressure roller means, pressure roller support means, guide means guiding said pressure roller means for movement in opposite directions in said support means and spring means acting between said pressure roller means and said support means to urge said roller means in one of said directions, means mounting said pressure roller units in said frame in two groups so that the pressure roller means of each of the two groups are urged towards the pressure means of the other of said groups and so that said superimposed sheets curved in a plane transverse to the rolling direction can be rolled between the pressure roller means of the two groups, said mounting means comprising individual mounting means for each said pressure roller unit adapted to permit individual removal of each pressure roller unit and adapted to allow individual adjustment of the position of each said support means in a plane perpendicular to the rolling direction whereby the apparatus is adjustable for laminates having different curvatures in the rolling direction.

2. The apparatus of claim **1** wherein said frame comprises two bar members extending perpendicular to said pivotal axis and means pivotally mounting said bar members for pivoting about said axis, said frame further comprising cross bar means connecting said bar members on opposite sides of said axis, said mounting means mounting one of said groups of pressure roller units on the cross bar means on one side of said axis and mounting the other of said groups of pressure roller units on the cross bar means on the other side of said axis.

3. The apparatus of claim **2** wherein each of said two bar members comprises three parts detachably joined end to end, a central part of each said bar member bearing said pivot means and said cross members being connected between respective each parts of said bar members.

4. The apparatus of claim **3** wherein adjacent ends of adjacent parts of each said bar member are provided with co-operating endplates which are held in abutment with each other by screws.

5. The apparatus of claim **4** wherein said endplates are provided with complementary tongues and grooves which co-operate to ensure alignment of said parts transversely of the rolling direction.

6. The apparatus of claim **4** wherein said abutting endplates each have the same length in a direction perpendicular to said axis and to the length of said bar members so that the bar member parts can be aligned in the last said direction by aligning the edges of said abutting endplates which face in said direction.

7. The apparatus of claim **1** wherein in each said pressure roller unit, said support means comprises an elongated housing and said guide means comprises a guide rod one end of which extends from the housing and supports the pressure roller means said guide rod being slidable longitudinally in said housing and being rotatable in said housing about its longitudinal axis, a helical compression spring being disposed within said housing around said rod, one end of said spring bearing on one end of said housing and the other end of said spring bearing on abutment means on said guide rod.

8. The apparatus of claim **7** wherein in each said pressure roller unit, the end of said guide rod remote from said roller means also extends from said housing, and said housing includes a housing body and stop means at the end of the housing body remote from said pressure roller means, said spring bearing at one end on an abutment on said guide rod intermediate the ends thereof and at the other end on said stop means, said stop means being adjustable longitudinally of the housing body.

9. The apparatus of claim **8** wherein said stop means is a sleeve screw threaded into one end of said housing body and through which said guide rod passes slidably, said sleeve forming a closure for said housing.

10. The apparatus of claim **7** wherein said cross member means on each side of said axis comprises a pair of cross beams extending parallel with said axis and spaced at different distances therefrom, and each pressure roller unit is provided with two projections each having an abutment surface to bear on one of said beams and each having a slot of T-shaped cross section, said mounting means including at least one block of T-shaped cross section engaged in each said slot and means detachably securing said blocks to the associated said cross beams.

11. The apparatus of claim **10** wherein each said cross member is provided with a plurality of apertures and said means detachably securing said T-shaped blocks to the associated cross beams comprises, for each of said T-shaped blocks, two screws engaging the block and each passing through a different one of said apertures in the associated cross beam.

12. The apparatus of claim **11** wherein said apertures are slots extending longitudinally of said cross beams.

13. The apparatus of claim **1** including feed roller units each comprising feed roller means and feed roller support means, the apparatus further including drive means for driving the feed roller means and mounting means mounting said feed roller units in said frame, said

mounting means comprising individual mounting means for each feed roller unit adapted to permit individual removal of each feed roller unit and individual adjustment of the position of each said feed roller support means in a plane perpendicular to the rolling direction.

14. The apparatus of claim **13** wherein said feed roller support means are each provided with T-section slots and said mounting means for each feed roller support member comprises T-section bars fitting in said slots and means for detachably securing said bars to said frame.

15. The apparatus of claim **7** wherein in each said pressure roller unit, the longitudinal axis of said guide rod is displaced in front of the axis of rotation of said pressure roller means in the rolling direction whereby when said laminate is passed between said groups of

pressure roller means the pressure roller means adjusts itself in a self-aligning manner around the longitudinal axis of the guide rod.

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DOUGLAS J. DRUMMOND, Primary Examiner

U.S. Cl. X.R.

100—168, 155 G