United States Patent

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Japan
[31] **42/67409**

[54] **SHEET MATERIAL PROCESSING APPARATUS**
8 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **263/3,** 34/152, 34/158

[51] **Int. Cl.** **F27b 9/28**
[50] **Field of Search** 266/3; 263/3; 34/152, 158

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ABSTRACT: A sheet material processing apparatus wherein a sheet of material is held in a curved position so as to have a curved cross section in a plane perpendicular to the direction in which it is fed and processed.

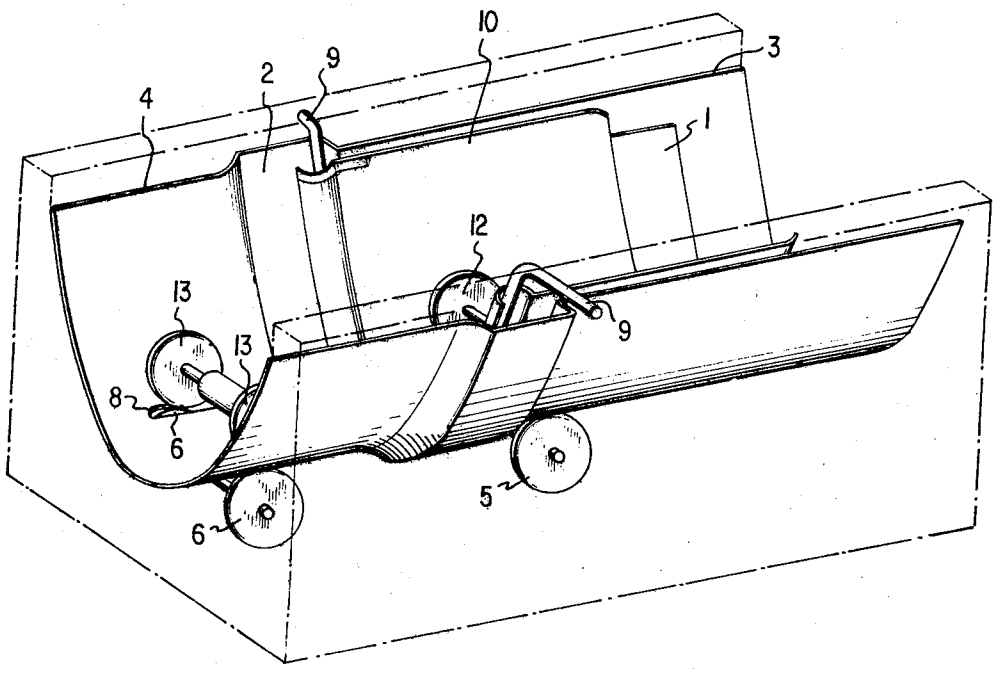
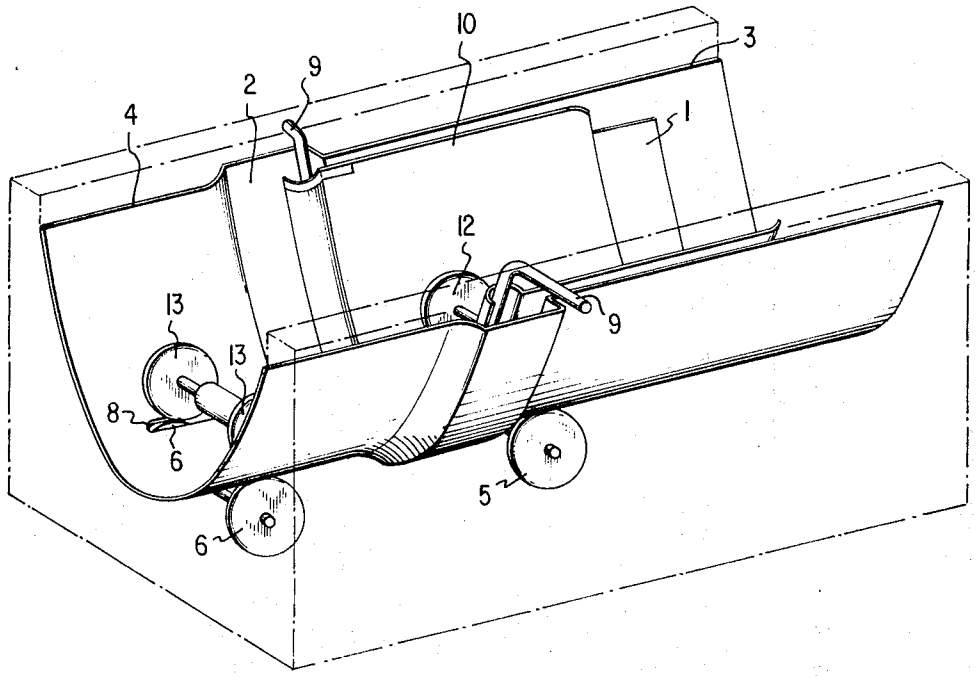


FIG. 1



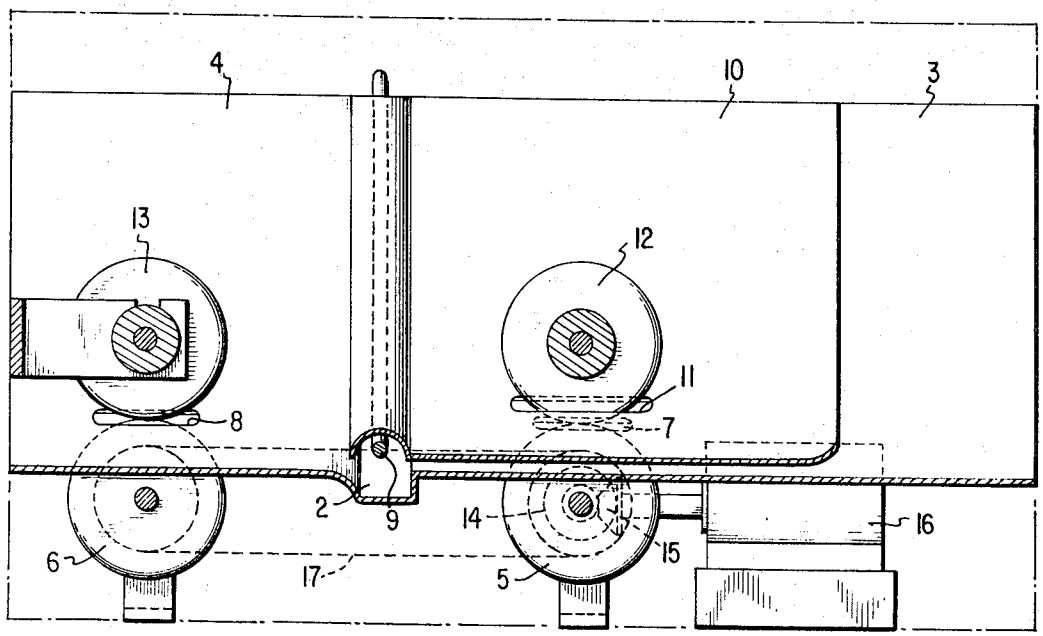


FIG. 2

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FIG. 3

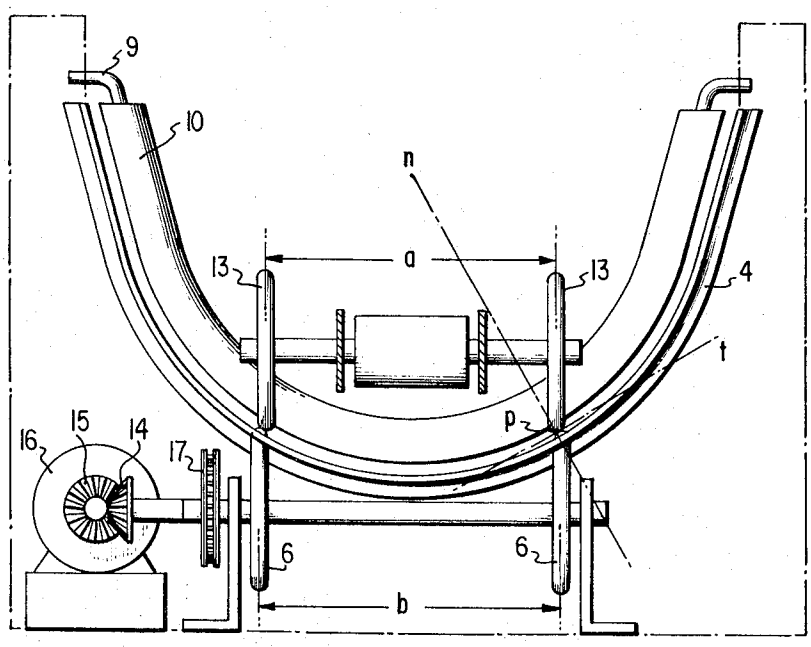


FIG. 4

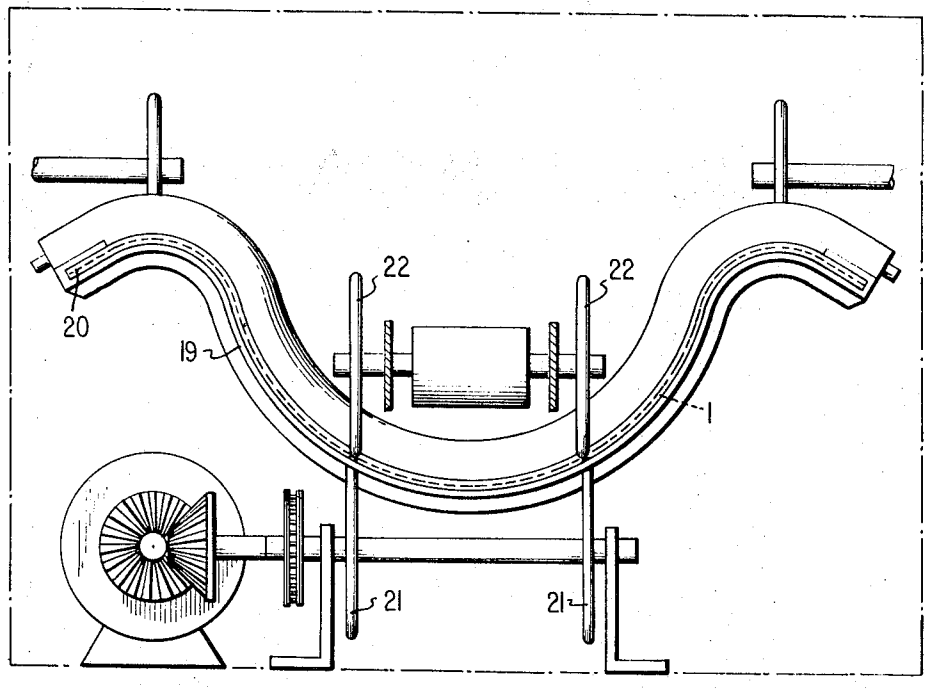
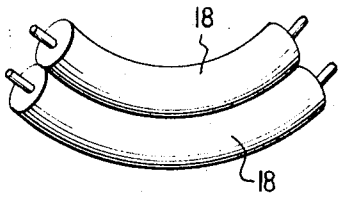


FIG. 5



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SHEET MATERIAL PROCESSING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to a processing apparatus for sheet like materials such as papers, cloths, plastics, sheet metal and the like. In feeding and processing the sheet like material, the sheet like material is apt to be bent or curled because of this low rigidity. In a conventional sheet material processing apparatus, the sheet like material is held in a plane and moved along in a straight line while the material is coated with a liquid agent, heated, or dried. In such conventional processing apparatus, however, the sheet material is passed in a plane shape through the processing portions, which results in the surface to be processed coming into contact with some portions of the processing areas of the processing apparatus when the sheet material is curled, expanded, constructed, or made adhesive. In order to prevent the disadvantages described above, complicated support structure is required for holding the sheet material during and after processing.

SUMMARY OF THE INVENTION

The present invention provides a processing apparatus for sheet material wherein the sheet material is fed in a particular shape so as to compensate for the low rigidity of the material and enable it to be processed more effectively.

In general, the sheet material is not curled or bent down if the sheet material is held in a curved plane so that its cross section is curved in the shape of an arc, a wave shape or other curvature in a plane perpendicular to the advancing direction.

It is an object of the present invention to provide a processing apparatus wherein a simplified holding structure is disposed for protecting the surface of the sheet material during or after processing, by feeding and processing the sheet material in a stable condition in spite of curling or expanding thereof by utilizing the above described principle for feeding the material without making it bend downwardly.

It is another object of the present invention to provide a processing apparatus wherein a relative positions of the sheet material is stable at each position within the processing areas of the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a heat developing processing apparatus for sheet material in accordance with the present invention;

FIG. **2** is a schematic side view of the main part of the apparatus shown in FIG. **1**;

FIG. **3** is a schematic front view of the main part of the apparatus shown in FIG. **1**;

FIG. **4** is a schematic front view of the main part of the processing apparatus in accordance with the second embodiment of the present invention; and

FIG. **5** is a perspective view of a portion of the processing apparatus in accordance with the third embodiment for the present invention

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the following embodiments, a heat developing apparatus is disclosed for heating a heat developable photosensitive material for example a photosensitive material consisting of a base layer in a photosensitive emulsion layer coated thereon which has a number of microcapsules containing a developing solution which are broken with heat.

Referring to FIGS. **1** through **3**, an apparatus as disclosed wherein a heat developing photosensitive material in the form of a sheet is fed and processed while being held in an accurate quadratic curve in cross section in a plane perpendicular to the advancing direction. A heat developing photosensitive material **1** is fed through the heat treating portion **2** from a first half guide portion **3** to the second half guide portion **4**. The guide portions **3** and **4** are provided at the bottom thereof with slots **7** and **8** respectively to allow the feeding wheels **5** and **6** to pass through in an upward direction. The guide portions **3** and **4** are covered with an auxiliary guide member **10** for guiding the sheet material **1** and locating the heat treating heater **9** at the heat treating area **2**. The guide member **10** is provided with a slot **11** to allow the feeding wheel **12** to pass through in a downward direction. The feeding wheels **12** and **13** are disposed above the feeding wheels **5** and **6** respectively for feeding the sheet material **1**.

As best shown in FIG. **3**, the spacing *a* between the two feeding wheels **12**, **13** is shorter than the spacing *b* between the two feeding wheels **5**, **6**. The tangent line *t* common to the two contacting feeding wheels **12**, **13** meets at a right angle with the normal line *n* of the guide portions **3** and **4** at the point *P*. Feeding wheels **12**, **13** grasp the sheet material **1** put into the spacing between the upper feeding wheels **12**, **13** and the lower feeding wheels **5**, **6** by the weight of the upper feeding wheels themselves, and feed the grabbed material **1** by their rotation. The lower feeding wheels **5** and **6** are driven by the driving source **16**. The lower feeding wheel **5** is rotated by the motor **16** through driving force transmitting gear **14**, **15** and the outer feeding wheel **6** is rotated by chain **17** driven by feeding wheel **5**.

When the sheet like heat developable photosensitive material **1** is put into the apparatus shown in FIG. **2** from the right side as shown in the drawing, the heat developable photosensitive material **1** is curved along the internal curved surface of a first half guide portion **3** by the weight of the sheet material itself. If the sheet material **1** is not curved completely along the curved surface of the first guide portion **3**, the auxiliary guide member **10** makes it completely curved. If the sheet material curves excessively, the auxiliary guide member **10** also corrects this. When the fore end of the heat developable photosensitive sheet material **1** reaches the feeding wheel **12**, it continues to be guided by the feeding wheels **5** and **12** through the heat treating area **2** adjacent the heat treating heater **9**, and is then fed into the second half guide portion **4** and continues to be fed in its curved position by the feeding wheels **6** and **13**. Thus, the heat developable photosensitive sheet material **1** is held in the curved condition while being fed and processed without folding because of the weight of the solution during development or curled because of the dryness of material as a result of the drying process in the heat treating area. After the processed surface of the heat developable photosensitive material is made stable, the processed surface is brought into contact with the feeding wheels **6** and **13**.

FIG. **4** illustrates the embodiment of the present invention wherein the heat developable photosensitive sheet material **1** is fed and heat treated in a curved position having a waved cross section in the plane perpendicular to the advancing direction. The guiding member **19** has a waved section disposed in the apparatus and is provided with guiding grooves **20**, located at the opposite edges thereof. The feeding wheels **16** and **17** are the same as the wheels shown in FIGS. **1** through **3**, however, the auxiliary guide member **10** and the heat treating heater **9** are waved to correspond to the guiding member **19**. In the processing apparatus shown in FIG. **4**, the heat developable photosensitive material **1** is fed and processed in the waved condition by the groove **20** and the feeding wheel **21** and **22**. This apparatus shown for feeding and processing the heat developable photosensitive sheet material in its waved condition has the advantage that wider sheet material can be fed and processed in comparison to the other apparatus which feeds and processes the sheet material in a curved condition.

In the foregoing description, only the embodiments of various heat treating apparatus are disclosed. In another embodiment, an apparatus for spraying chemicals or for coating is disclosed. A spraying or coating device is used instead of the heat treating heater **9** in the above described embodiments. The feeding wheels may be made of elastic material in the form of rollers **18** as shown in FIG. **5**, or they may be any other suitable feeding mechanism.

According to the present invention as described above, a sheet like material is fed through the processing portion of the apparatus by guiding means wherein the sheet like material is fed in a curved condition by the curved guide plate having a curved section in the plane perpendicular to the advancing direction and by feeding wheels and the like, and as a result, the sheet like material is not curved by expansion or contraction thereof and does not collapse because of its own weight and the weight of the solution on it. The sheet like material is also stable and easily coated. And further because the sheet material is put into the apparatus in a bent or curved condition, the apparatus can be made smaller in size and can process wider sheet material.

The inventor found that in treating heat developable photosensitive sheet material, the apparatus in accordance with the present invention was particularly effective for preventing sheet material from curling or folding or getting wrinkled in the heating process or developing process due to its dry or wet condition.

The present invention has been described with particular reference to the particular embodiments thereof, but it should be understood that variations and modifications can be effected within the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A sheet material processing apparatus comprising:

a. a guide member in the form of a chute having a surface curved in the plane perpendicular to the direction in which the sheet material is fed; and

b. means for feeding said sheet material in the curved condition resulting from contact with said guide member, and longitudinally extending slots carried by said guide member for accommodating said sheet material feeding means.

2. The apparatus as claimed in claim 1, further comprising an auxiliary guide member in the form of a second chute, concentrically carried within said first chute and defining a narrow arcuate slot therebetween for passage of sheets therethrough, means intermediate said member and said auxiliary guide member guide and adjacent said curved sheet material for subjecting said sheet material to a specific treatment.

3. The apparatus as claimed in claim 2, wherein said sheet material feeding means comprises a first pair of spaced apart wheels protruding through said slots and into the path of said sheet material and a second pair of spaced apart wheels disposed adjacent to said first pair of wheels for engaging and feeding said sheet material therebetween.

4. The apparatus as claimed in claim 2, wherein said sheet feeding means comprises a first pair of spaced apart wheels protruding through said slots and into the path of said sheet material, and a second pair of spaced apart wheels disposed adjacent to said first pair of wheels for engaging and feeding said sheet material therebetween.

5. The apparatus as claimed in claim 4, further comprising longitudinal slots carried by said second chute and overlying the slots carried by said first chute with said first pair of wheels protruding through the slots of said first chute, and said second pair of wheels protruding through the slots of said second chute.

6. A sheet material processing apparatus comprising:

a. a guide member in the form of a chute having a surface curved in the plane perpendicular to the direction in which the sheet material is fed;

b. means for feeding said sheet material in the curved condition resulting from contact with said guide member;

c. said guide member being waved shaped in the plane perpendicular to the direction in which the sheet is fed; and

d. further means adjacent the outer edges of said waved shaped surface for feeding said sheet material.

7. The apparatus as claim in claim 6 wherein said guide member is integrally grooved to limit lateral movement of said sheet material.

8. The sheet material processing apparatus as claimed in claim 1, wherein said sheet material feeding means comprises first roller means protruding through said slots and into the path of said sheet material and second roller means disposed above said first roller for engaging and feeding said sheet material therebetween.