Nov. 17, 1953 E. R. MERRITT 2,659,103

KNEE ACTION DOPE HOPPER FINGER

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Fig. 1

PRIOR ART

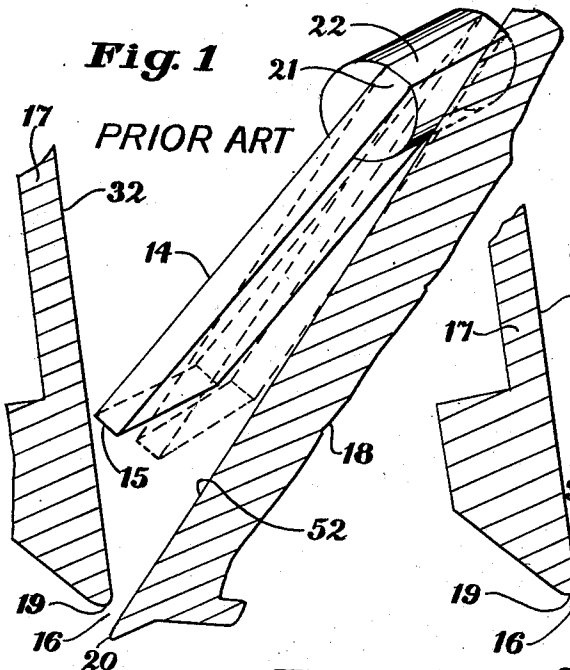

Fig. 4

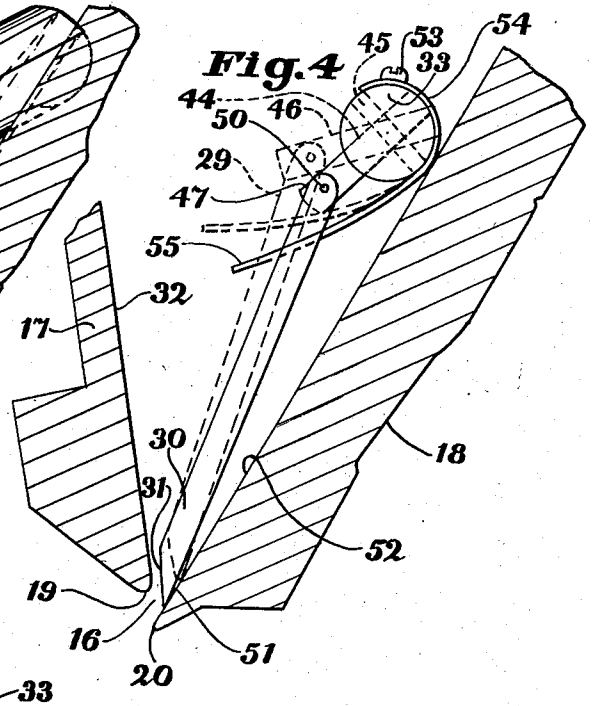

Fig. 5

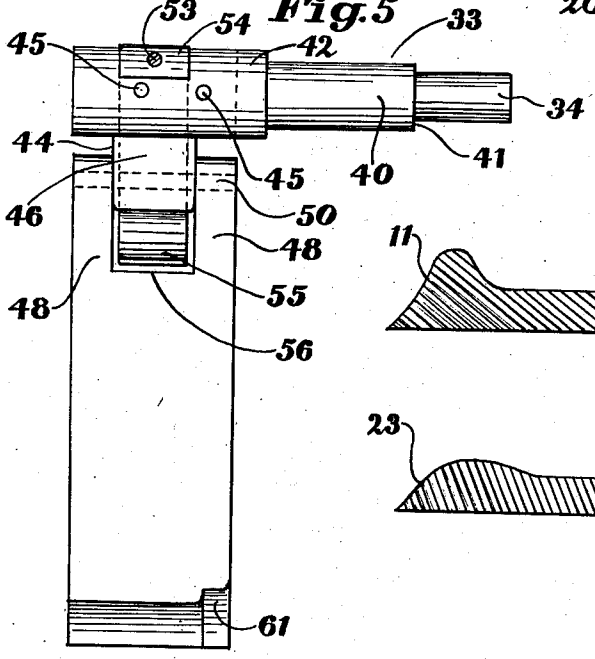

Fig. 2

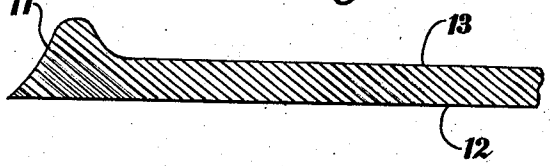

Fig. 3

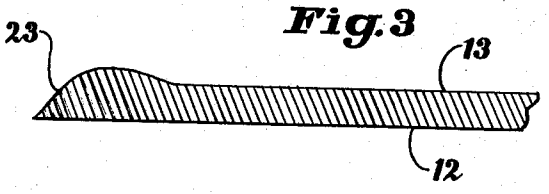

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Fig. 6

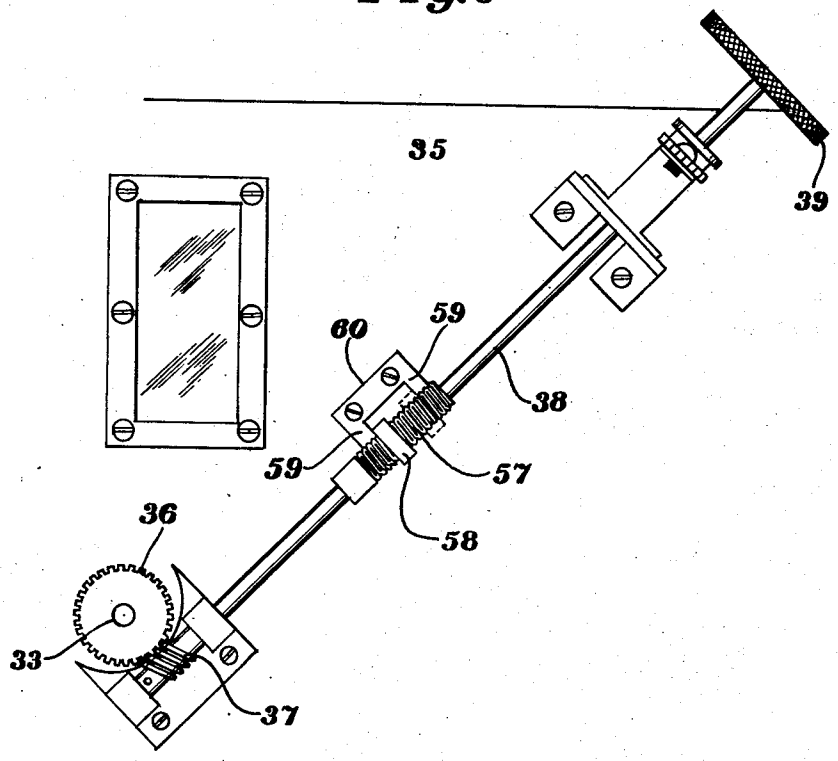


Fig. 7

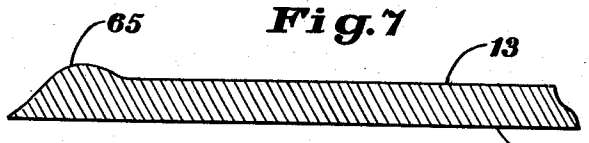
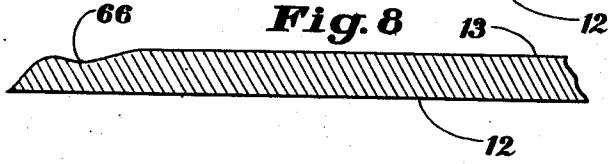


Fig. 8



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UNITED STATES PATENT OFFICE

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KNEE ACTION DOPE HOPPER FINGER

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Application August 23, 1951, Serial No. 243,327

10 Claims. (Cl. 18—15)

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The present invention relates to coating hoppers used to coat sheet-forming materials onto a suitable supporting surface which is usually movable relative to the hopper. More particularly, the invention relates to fingers positioned in the ends of the hopper to control the thickness of the sheet adjacent the ends or side edges thereof.

In coating certain materials such, for example, as a cellulose ester used in forming a film base, the solution is fed from a hopper formed with inclined sides which taper downwardly and are spaced at the lower ends to provide a discharge or coating slot. In coating certain materials it is found that the material tends to "neck in" at the ends of the slot so as to provide sheets having the edges thereof of a non-uniform and undesirable thickness. In order to overcome this necking-in, and to provide a sheet having an optimum or suitable edge thickness, edge fingers have been positioned in the hoppers adjacent the opposite ends thereof with the ends of the fingers positioned adjacent the opposite ends of the slots. These end fingers were found somewhat satisfactory for certain types of materials, and at certain coating speeds. However, with the advent of pressure hoppers it was found that the prior finger design did not provide the desired control of the edge thickness of the sheet.

In order to overcome these disadvantages, the present invention provides a new and improved form of edge finger, and an improved arrangement for mounting and adjusting the finger so as to obtain the desired edge thickness for a wide variety of coating materials and a wide range of coating speeds.

The present invention has as its principal object the provision of a new and improved design of an edge finger.

A further object of the invention is the provision of a novel mounting for said finger so that the latter may be adjusted to give the desired edge thickness of the sheet for a wide range of materials and coating speeds.

A still further object of the invention is the provision of an edge finger construction which does not necessitate the shutting down of the machine due to changes in the product or coating speed.

Yet another object of the invention is the provision of an edge finger construction which is simple in design, easy to operate, comprises few parts of rugged construction, and is highly effective in use.

To these and other ends the inventive idea resides in certain improvements and combinations of parts, all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

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In the drawings:

Fig. 1 is a partial vertical sectional view through a hopper of well known design, showing the relation thereto of an edge finger construction of the type used prior to the present invention;

Fig. 2 is a transverse sectional view through a cast sheet or film of the type secured without the use of any edge fingers;

Fig. 3 is a view similar to Fig. 2 showing the type of sheet secured under cretain definite conditions of material and coating speed with the finger construction shown in Fig. 1;

Fig. 4 is a view similar to Fig. 1 but showing the application to the hopper of the edge finger construction and the finger mounting of the present invention.

Fig. 5 is a front view of the finger construction of the present invention detached from the hopper;

Fig. 6 is an end elevation view of the outside of the end wall of the hopper, showing the arrangement of the adjusting and control means for the finger;

Fig. 7 is a view similar to Figs. 2 and 3 showing the controlled form of edge secured by the edge finger of the present invention; and

Fig. 8 is a view similar to Fig. 7 showing a modified arrangement of the edge construction possible with the edge finger of the present invention.

In the process of coating a solution to form a film base or sheet, there is a combination of flowing and stretching of the solution as it leaves the hopper. This stretching causes a "necking-in" of the material between the discharge slot of the hopper and the coating wheel or surface. Such "necking-in" increases the thickness of the sheet at the edges thereof, and as shown at 11 of Fig. 2. In the sectional views of the sheets, Figs. 2, 3, 7 and 8, the surface 12 represents the portion of the coated sheet in contact with the coated surface or wheel, while the surface 13 represents the top surface of the coated or cast sheet. Due to this "necking-in" condition, it is impossible to coat or cast film base materials from a pressure hopper without employing edge fingers for controlling the sheet thickness at the extreme edges of the sheet. To aggravate the condition the thickened edge area 11 tends to stick to the coating surface, the disadvantages of which are deemed apparent. A pressure hopper is one in

which the material therein is under pressure and the extrusion is due to the pressure and not merely to the bead of material in the hopper. However, as such pressure hoppers form no part of the present invention, they are not specifically illustrated or described.

In order to overcome this undesirable edge thickness, flat, straight paddle fingers 14 were installed in the ends of the hopper. Each of these fingers was of the shape best shown in Fig. 1, and had a lower flat or square end 15 positioned adjacent the discharge slot 16 of the hopper which is formed with inclined side walls 17 and 18 which extend downward to terminate in discharge slot 16, as best shown in Figs. 1 and 4. As the hopper, per se, forms no part of the present invention, it may be of any suitable or standard construction so long as it has tapered sides 17 and 18, the lower edges 19 and 20 of which are spaced to form the discharge slot 16. The upper end 21 of the flat paddle is secured to a control shaft 22, as best shown in Fig. 1. The result is that by rocking the shaft, the paddle finger may be adjusted as shown in solid and dotted lines, Fig. 1.

It will be apparent that if the shaft 22 is rocked, the position of the lower end 15 of the finger 14 may be moved laterally relative to the slot 16 and the walls 17 and 18. It is also apparent that in all but one position of adjustment the end 15 will be out of contact with wall 18, and the end 15 will be positioned intermediate the walls, as shown in Fig. 1. In all of these intermediate positions, the solution in the hopper is free to flow on both sides of the finger, so that the latter does not serve to control the effective width of the slot 16. It was found, however, that with the use of the straight finger paddle 14, and with certain types of materials and at certain coating speeds and acceptable edge thicknesses, as shown at 23, Fig. 3, might be secured. In addition, these paddle fingers tend to stop or reduce sticking of the material to the coating surface at the thickened end portions 11. While this prior arrangement was somewhat satisfactory with a few types of materials, and over a limited range of coating speeds, it was found that the thickness at 11 varied whenever the speed was changed.

On some materials and thicknesses of product, the edge thickness must be slightly greater than the overall thickness of the sheet in order to maintain satisfactory operation. On the other hand, with another thickness of product, the edge thickness must be less than the overall thickness of product, the edge thickness must be less than the overall thickness to maintain satisfactory operations. However, with the paddle type finger construction shown in Fig. 1, due to the fixed vertical position of the finger 14, it was necessary to shut down the machine and install a new finger of different length in order to secure a product having a different edge thickness whenever the coating material or coating speeds were changed. Also, with the development and improved methods, it was found that when changing the coating temperature, or increasing coating speed without changing the solution, the paddle fingers, Fig. 1, no longer gave the desired results. Under certain specific conditions, the highly desirable edge thickness shown at 23, Fig. 3, might be secured even when using the paddle fingers illustrated in Fig. 1. It was found, however, that any given length paddle finger gave satisfactory results only at one thickness of product and only over a limited speed range. Obviously, such a limitation is highly undesirable when high production is desired.

In order to overcome the disadvantages and limitations of this prior paddle type finger, Fig. 1, the present invention provides a new and highly improved knee action type finger generally indicated by the numeral 29 and best shown in Figs. 4 and 5. This new type of finger is of the shape best shown in Figs. 4 and 5, and has the lower end portion 30 positioned adjacent or actually in the slot 16, see Fig. 4. The left face 31 of portion 30, as viewed in Fig. 4, is inclined or tapered so that it is substantially parallel to the adjacent inner surface 32 of the hopper wall 17, and cooperates therewith to form the effective width of the discharge slot 16, as is deemed apparent. Instead of connecting the upper end of the finger directly and rigidly to a shaft, as in the case of the paddle type finger, the finger 29 of the present invention is connected to its operating and supporting shaft 33 through a knee action mechanism to be presently described. The shaft 33 is formed with a reduced end portion 34 which extends through an end wall 35 of the hopper, see Fig. 6. This portion 34 carries a worm wheel 36 which engages a worm 37 carried by an adjusting shaft 38 the upper end of which has connected thereto a hand wheel 39 by which shafts 38 and 33 may be adjusted. The shaft 33 has an intermediate portion 40 of larger diameter than and is connected to the portion 34 by means of a shoulder 41 which engages the inner face of the end wall 35 to position the finger 29 laterally relative to the end of the hopper. The left end portion 42 of shaft 33, as viewed in Fig. 5, is of a larger diameter than the intermediate portion 40, and has secured thereto one end of a connecting member 44 which extends radially or laterally from shaft 33. The member 44 may be connected to shaft 33 in any suitable manner. However, in the preferred arrangement, portion 42 is formed with an open end axial slot to provide a pair of spaced members or bifurcations. The member 44 is T-shaped and has a head portion positioned in the slot 42. Pins or rivets 45 are positioned in aligned apertures formed in the bifurcations of the portion 42 and the head portion of member 44 to secure the latter rigidly to shaft 33. This method of securing member 44 to shaft 33 is not intended as a limitation, but merely as one arrangement by which member 44 may be secured to control shaft 33. Other means of securing member 44 to shaft 33 will readily suggest themselves to any mechanic. Suffice it to say, as the member 44 has one end anchored to shaft 33 to provide a stem or portion 46 which projects laterally or radially from shaft 33, and has its outer or free end 47 positioned between the bifurcation 48 formed on the upper end of finger 29, as best shown in Fig. 5. A pin 50 connects end 47 and bifurcation 48 to connect finger 29 pivotally to member 44. Thus, the finger 29 is swingably or pivotally connected to shaft 33, and the finger member 44 constitutes a "knee action" connection between the finger 29 and the shaft 33.

It will be deemed apparent that if the wheel 39 is now rotated, shaft 38 will also be rotated, and such rotation will be transmitted through worm 37 and worm wheel 36 to rotate shaft 33. Rotation of the latter will carry with member 44 to move finger 29 vertically, as indicated in solid and dotted lines, Fig. 4. However, in all positions of adjustment, the inclined face 31

of portion 30 cooperates with the adjacent portion of the face 32 of wall 17 to form the effective width of the discharge slot. This arrangement is to be compared with the prior structure, shown in Fig. 1, in which the paddle type finger in no way cooperates to control the effective slot width.

In order that the face 31 may be effective in controlling the slot width, the finger 29 is yieldably urged in a counterclockwise direction about pivot pin 50 so as to retain face 51 of portion 30 in positive engagement with the inner surface 52 of the wall 18 adjacent slot 16 for all positions of adjustment of the finger. Thus, the lower end of the finger is always positively and yieldably held in positive engagement with the wall 18 so that the face 31 will always cooperate with face 32 of wall 17 to control the effective width of the slot, as clearly illustrated in Fig. 4. To this end the portion 42 of shaft 33 has secured thereto by a set screw 53, an arcuate portion 54 of a centilever spring, the free end 55 of which projects, as shown in Figs. 4 and 5, between the bifurcations 48, and engages the surface 56 of finger 29 between the bifurcation 48 as best shown in Fig. 5. It will be apparent from an inspection of Fig. 4, that the end 55 of the cantilever spring acts on the finger 29 adjacent the connection 50 and tends to rotate or rock finger 29 in a counterclockwise direction about connection 50 to retain the face 51 of the lower end of the finger 29 always in positive yet yieldable engagement with the adjacent surface 52 of the wall 18 for all vertical positions of the finger. With this arrangement, the lower end of the finger always cooperates with surface 32 to control the effective width of the discharge slot 16. Also, as the finger 29 is raised, as shown in the dotted lines, Fig. 4, the effective width of the slot may be increased. On the other hand, the lowering of the finger surface decreases the effective width of the slot. Also, the position of the finger is determined by the degree of rotation of the control shaft 33 which, in turn, is adjusted by shaft 38 and wheel 39.

Thus, the position of finger 29 may be readily, easily and quickly adjusted from a point outside the hopper without necessitating the touching of the finger 29 by the operator or shutting down the machine. The position of the finger may be adjusted to provide the desired edge thickness for a wide range of materials and substantially any coating speeds usually employed in machines of this type without necessitating the shutting down of the machine. For example, the finger may be adjusted giving the thickened edge as shown 65 in Fig. 7, or the thin edge shown at 66 in Fig. 8. Such variations in edge control are obtained by the use of the simple finger and "knee action" control of the present invention, thus eliminating the necessity of employing different finger arrangements to secure different edges or the same edge with different materials and different coating speeds, and also eliminating shutting down of the machine to change the finger to secure the desired edge thickness.

In operation, the finger 29 is moved through a definite range of adjustment. In order that the operator may maintain the finger within this range, limiting means are provided to limit the adjustment of the finger. To secure this result, the intermediate portion of shaft 38, Fig. 6, is formed with a threaded portion 57 which

engages a nut 58 which is movable between spaced abutments or shoulders 59 formed on a bracket 60 secured to the outer surface of the wall 35, as shown in Fig. 5. When the nut 58 engages with one of the shoulders 59, as shown in dotted and flat lines, Fig. 6, the limit of adjustment has been reached, and the shaft 38, and hence shaft 33, and finger 29 will be locked against further movement. This locking indicates to the operator that finger 29 has been moved to one of its limits of adjustment. In case the ends of the hopper are provided with corner pieces, not shown, the lower edge of the finger 29 is beveled, as shown at 61, to permit complete closing of the slot, when desired.

The present invention thus provides a "knee-action" control mechanism for an edge finger which enables the operator to control the edge thickness of the formed sheet for a large number of materials and over a wide range of speeds. The adjustment of the finger may be actuated and controlled without necessitating the shutting down of the machine. Also, with changes of materials, different fingers are not required. The finger construction of the present invention is simple, easy to operate and adjust, comprises few parts of rugged construction and is highly effective in use.

While one embodiment of the invention has been disclosed, it is to be understood that the inventive idea may be carried out in a number of ways. This application is, therefore, not to be limited to the precise details described, but is intended to cover all variations and modifications thereof falling within the scope of the appended claims.

What I claim and desire to secure by Letters Patent of the United States is:

1. In a sheet-forming device, the combination with a hopper formed with inclined sides terminating in a discharge slot for feeding a sheet-forming solution from said hopper, of a control finger positioned in said hopper adjacent an end only thereof, said finger having a lower end portion thereof positioned adjacent said slot and in engagement with one of said sides only adjacent said slot and cooperating with the other of said sides to adjust the effective end width of said slot to control the edge thickness of said sheet, the balance of said finger being spaced from said one side means to adjust said finger toward and away from said slot and to maintain said lower position in positive engagement with the said one side, and a "knee-action" connection between the upper end of said finger and said adjusting means to rock said upper end to move said lower end along said one side and relative to said other side to adjust said slot.

2. In a sheet-forming device, the combination with a hopper formed with inclined sides terminating in a discharge slot for feeding a sheet-forming solution from said hopper, of a control finger positioned in said hopper adjacent an end thereof, said finger having an end portion thereof positioned adjacent said slot and cooperating with one of said sides to adjust the effective end width of said slot to control the edge thickness of said sheet, means to adjust said finger toward and away from said slot, a "knee-action" connection between said finger and said adjusting means, and means carried by said adjusting means for maintaining said portion in positive engagement with said other side for all positions of said finger.

3. In a sheet-forming device, the combination with inclined sides terminating in a discharge slot for feeding a sheet-forming solution from said hopper, of a control finger positioned in said hopper adjacent an end thereof, said finger having an end portion thereof positioned adjacent said slot and cooperating with one of said sides to adjust the effective end width of said slot to control the edge thickness of said sheet, means to adjust said finger toward and away from said slot, a "knee-action" connection between said finger and said adjusting means, and spring means carried by said adjusting means and directly engaging said finger to hold said portion yieldably in positive engagement with said other side for all positions of adjustment of said finger.

4. In a sheet-forming device, the combination with a hopper formed with inclined sides terminating in a discharge slot for feeding a sheet-forming solution from said hopper, of a control finger positioned in said hopper adjacent an end thereof, said finger having an end portion thereof positioned adjacent said slot and cooperating with one of said sides to adjust the effective end width of said slot to control the edge thickness of said sheet, means to adjust said finger toward and away from said slot, a "knee-action" connection between said finger and said adjusting means, and a spring carried by said adjusting means and engaging said finger adjacent said connection to hold said portion yieldably in positive engagement with said other side for all positions of adjustment of said fingers.

5. In a sheet-forming device, the combination with a hopper formed with inclined sides terminating in a discharge slot for feeding a sheet-forming solution from said hopper, of a control finger arranged in suspended relation in said hopper and having the lower end portion positioned adjacent said slot and engaging one of said sides and cooperating with the other of said sides to control the effective end width of said slot to control the edge thickness of said sheet, means for moving said finger to adjust the vertical position of said portion along said one side and relative to said slot to vary the effective end width of said slot, means within said hopper pivotally connecting the other end of said finger to said adjusting means, and spring means carried by said adjusting means and engaging said finger adjacent said connection to hold said portion yieldably in contact with one side of said hopper adjacent said slot for all positions of adjustment of said finger.

6. In a sheet-forming device, the combination with a hopper formed with inclined sides terminating in a discharge slot for feeding a sheet-forming solution from said hopper, of a control finger arranged in suspended relation in said hopper and having the lower end portion positioned adjacent said slot and engaging one of said sides and cooperating with the other of said sides to control the effective end width of said slot to control the edge thickness of said sheet, a shaft positioned directly in said hopper above said slot, a "knee-action" connection in said hopper between said shaft and the other end of said finger, means for rotating said shaft to move said finger vertically to adjust said portion along said one side and relative to said slot to vary the effective end width of said slot, and spring means carried by said shaft and engaging said finger adjacent said connection to maintain said portion in yieldable engagement with one side of said hopper adjacent said slot for all positions of adjustment of said finger.

7. In a sheet-forming device, the combination with a hopper formed with inclined sides terminating in a discharge slot for feeding a sheet-forming solution from said hopper, of a control finger arranged in suspended relation in said hopper and having the lower end portion positioned adjacent said slot and engaging one of said sides and cooperating with the other of said sides to control the effective end width of said slot to control the edge thickness of said sheet, a shaft positioned within said hopper above said slot, a member secured to and projecting radially from said shaft, means within said hopper to connect the other end pivotally to the upper end of said finger to provide a "knee-action" connection between said finger and said shaft, means to rock said shaft to move said lower portion of said finger vertically toward and away from said slot along said one side, and a cantilever spring having one end anchored to said shaft and the free end engaging said finger adjacent said pivot connection to hold said portion yieldably in positive engagement with one side of said hopper for all positions of adjustment of said finger so that the effective end width of said slot is controlled by said portion and said one side adjacent said slot.

8. In a sheet-forming device, the combination with a hopper formed with inclined sides terminating in a discharge slot for feeding a sheet-forming solution from said hopper, of a control finger arranged in suspended relation in said hopper and having a lower end portion positioned adjacent said slot and engaging one of said sides, a face of said portion being inclined and arranged substantially parallel to the other side of said hopper and cooperating therewith to control the effective end width of said slot, a shaft mounted in said hopper, a "knee-action" connection between the upper end of said finger and said shaft, means to rotate said shaft to adjust said portion vertically along said one side and relative to said slot to control the end width of the latter, and a spring carried by said shaft and engaging said finger adjacent said connection to hold an opposite face of said portion in yieldable positive contact with one side of said hopper adjacent said slot for all adjustments of said finger so that said the other side and said first face serve to control the effective end width of said slot.

9. In a sheet-forming device, the combination with a hopper formed with inclined sides terminating in a discharge slot for feeding a sheet-forming solution from said hopper, of a control finger arranged in suspended relation in said hopper and having a lower end portion positioned adjacent said slot and engaging said one side, a face of said portion being inclined and arranged substantially parallel to the other side of said hopper and cooperating therewith to control the effective end width of said slot, a shaft mounted in said hopper, a member secured to and projecting radially from shaft, means to connect the other end of said finger pivotally to the free end of said member to provide a "knee-action" connection between said finger and said shaft, means to rotate said shaft to adjust said portion along said one side and relative to said slot to control the end width of the latter, and a spring carried by said shaft and engaging said finger adjacent said connection to hold an opposite face of said portion in yieldable positive contact with one side of said hopper adjacent said slot for all adjust-

ments of said finger so that said the other side and said first face serve to control the effective end width of said slot.

10. In a sheet-forming device, the combination with a hopper formed with inclined sides terminating in a discharge slot for feeding a sheet-forming solution from said hopper, of a control finger arranged in suspended relation in said hopper and having a lower end portion positioned adjacent said slot and in engagement with one of said sides, a face of said portion being inclined and arranged substantially parallel to the other side of said hopper and cooperating therewith to control the effective end width of said slot, a shaft mounted in said hopper, a member secured to and projecting radially from shaft, means to connect the other end of said finger pivotally to the free end of said member to provide a "knee-action" connection between said finger and said shaft, means to rotate said shaft to adjust said portion

relative to said slot to control the end width of the latter, a cantilever spring carried directly by said shaft and engaging said finger adjacent said connection to hold an opposite face of said portion in yieldable positive contact with one side of said hopper adjacent said slot for all adjustments of said finger so that said the other side and said first face serve to control the effective end width of said slot, and means to limit the adjustment of said finger.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,351,652	Jarvis	Aug. 31, 1920
1,920,118	Walsh et al.	July 25, 1933
2,379,831	Scherer	July 3, 1945