

The invention relates to a calender for processing thermoplastic materials to form webs of material, in particular barrier foils for packaging foodstuffs, using preferably cooled calender rollers, wherein the distance between the centres of a pair of entry rollers is adjustable and one of the two entry rollers is arranged in a bottom frame and the other is arranged in a top frame which is adjustable relative to the bottom frame. By using a device of this kind, the thermoplastic mass preferably coming out of a wide slotted nozzle, is preferably rolled by cooling into webs of material. The number and arrangement of further calender rollers is in accordance with criteria which is dependent on the product, which criteria of course determine amongst other things the gap between the entry rollers. These kinds of calenders are known for example from DE-A 20 06 680, 26 39 447, DE-B-22 01 630 or from FR-A-1 569 613.

A particular problem exists because the thickness range of the webs of material which can be produced cannot fall below a lower limit of about $600\text{ }\mu\text{m}$, if the calender rollers are supposed to process webs of material up to 12 mm and more. It is generally known that it is difficult to produce particularly thin foil of uniform thickness, and for this purpose special devices have been developed.

The aim of the invention is now to create a calender of the kind mentioned in the introduction, by means of which it is possible to produce webs of material at least with a thickness range of $100\text{ }\mu\text{m}$ to 12 mm.

This is solved according to the invention, in that the top frame has a smoothing bar, wherein either the upper entry roller or the smoothing bar is associated with the entry roller of the bottom frame in two different operating positions.

Owing to the random combination of the entry rollers of the bottom frame with the entry roller of the top frame or the smoothing bar, depending on the task required, webs of material can be produced with a thickness range of about $10\text{ }\mu\text{m}$ to 12 mm. Webs of material are produced therein of

about 600 μ m to 12 mm in the usual way by using the pair of entry rollers, whilst the particularly thin webs of material between 100 μ m and 600 μ m are able to be produced by the association of the smoothing bar with the entry roller of the bottom frame. Then, the contact portion of the top frame which is not in use is in a position of rest.

According to a first embodiment there is provided that the top frame has a carriage which is displaceable in a sliding guide of the bottom frame. This enables there to be a particularly simple adjustment between the two operating positions. This adjustment is considerably facilitated if the sliding guide is pivotable on the bottom frame about an axis which is parallel to its entry roller.

According to another embodiment, there is provided that a second calender roller is mounted in the top frame pivotably about a parallel axis. Therefore, the operating position in which the pair of entry rollers is used is suitable for passing through the rollers of the top frame a web of material with a total thickness range between 600 μ m and 12 mm.

According to another embodiment, which allows the calender to be directly connected to the extrusion nozzle, there is provided that the smoothing bar is suspended pivotably on a swinging frame. Thereby, the smoothing bar can be removed from the level of the webs of material in the operating position of the pair of entry rollers in which the smoothing bar is to be displaced in the direction of the extrusion nozzle.

It is preferable if the smoothing bar has an air outlet nozzle, and can be arranged on the swinging frame so that it is adjustable in height, whereby when an adjustment is made to the thickness of the web of material, there is contact against the entry roller of the bottom frame exclusively by the air expelled in a jet through the nozzle, with the effect that the contact pressure is particularly easily adjustable, and can be selected so that it is substantially less than with a pair of rollers. The air issuing from the nozzle thereby serves simultaneously to cool the web of material.

It is preferable if a plurality of calender rollers is provided in the bottom frame which are connected to the entry rollers, so that even when the pair of entry rollers is in the operating position there is still the possibility for a selection to be made as to whether the web of material is guided through the rollers of the top frame or through the rollers of the bottom frame. Thus, in both sets of rollers, each roller can be driven separately by means of a thyristor driven direct current motor. For this purpose, there are two possibilities for the driving process: In synchronous running, a drive speed pre-determined by the guide drive (entry roller of the bottom frame) is transmitted synchronously to the consecutive drives. If the drive speed changes on the guide drive, then the speeds of the consecutive drives are changed to the same extent. With single running, like in synchronous running, a drive speed is pre-determined. In addition, the drive speed of each chrome roller can be altered separately by a potentiometer, in order to compensate for shrinkage of material. In each of the two control states it is possible to switch individual rollers on and off.

Figures 1 and 3 show illustrations of the calender according to the invention in the first operating position as the rolling mill (Figure 1), in the second operating position as the smoothing mill (Figure 2) and in an opened transitional position (Figure 3), in order to demonstrate the adjustability of the calender.

A calender according to the invention has a bottom frame 1 and a top frame 2, the surface area of which is in the form of a carriage 6. On the top side of the bottom frame 1 there is provided a sliding guide 7, the height of which is adjustable about an axis 8.

In the bottom frame 1 there is an entry roller 3 and subordinated thereto a plurality of cooled calender rollers 11. Associated with the entry roller 3 is also an entry roller 4 in the top frame 2, to which entry roller 4 a further calender roller 9 is connected. On the entry side there is pivotally mounted to the top frame 2 a swinging frame 10, which has a smoothing bar 5 at the lower end. Both the smoothing bar 5 and the swinging frame 10 are movable by means of appropriate adjustment devices in the direction of the arrow B, C, pointing in two directions, and shown in Figure 1. The calender

roller 9 of the top frame 2 is mounted in arms 14, which are displaceable in the direction of the arrow D, pointing in two directions.

In the operating position shown in Figure 1 for the production of webs of material with a thickness between $600\text{ }\mu\text{m}$ and at least 12 mm , there is, in the vicinity, a wide slotted nozzle 12 of the extruder. The top frame 1 is pushed onto the sliding guide 7 in its end position which is to the right in the diagram, in which position the axes of the rollers 9, 4 of the top frame and the entry roller 3 of the bottom frame 1 are in one plane. The smoothing bar 5 arranged on the swinging frame 10 is thereby raised into an upper position, so that it is in a position of rest above the wide slotted nozzle 12. When in this operating position it is still possible for the calender to guide the web of material over both rollers of the top frame 2 or over the individually activated rollers of the bottom frame 1. As can be seen from Figure 3, separate calender rollers 11 are mounted displaceably in the bottom frame 1, and likewise the calender rollers 9 of the top frame 2 which is disposed on the arms 14.

In order to produce very thin webs of material, with an approximate thickness of between $100\text{ }\mu\text{m}$ and $600\text{ }\mu\text{m}$, the calender rolling mill cannot be used in the conventional way according to Figure 1. For this purpose, the device is brought into the position shown in Figure 2, wherein the whole of the top frame 2 is pushed to the left on the sliding guide 7. Then, the smoothing bar 5 is lowered and the swinging frame 10 and the smoothing bar 5 are themselves tilted into the necessary angular position. Since the smoothing bar 5 preferably has an air outlet nozzle, which is supplied by a jet of air, the contact occurring by the air and the smoothing of the webs of material coming from the adjacent wide slotted nozzle 12 (Arrow A) can be controlled very exactly. Simultaneously, the air which is being expelled also cools the material so that the subsequent winding around at least of the entry roller 3 of the bottom frame 1 causes no damage or problems.

The invention is of particular significance to the production of barrier foils. These kinds of foils are composed of a plurality of layers of thermoplastic materials, wherein the covering layer can for example be polystyrene, polyethylene, polypropylene, and ethyl vinyl alcohol. A layer of foil is used

to form a barrier. Thus, for example, polyethylene prevents the escape of steam, and, thus, contents of yoghurt containers, for example, are prevented from becoming dehydrated. Ethyl vinyl alcohol forms a barrier for oxygen, which thus cannot penetrate through to the packaged food so as to alter it chemically. The thickness and composition of barrier foils vary greatly depending on application, wherein for reasons of quality, the use of calenders is desired in production if the thickness of the foils allows this. With the production of barrier foils, use can be made of the means made possible by this invention, and use will always be made of calenders without large adjustments being made as far as this is possible, and the smoothing bar will only be used when the foils are to be kept below a required minimum thickness.

CLAIMS

1. A calender for processing thermoplastic materials to form webs of material, in particular barrier foils for packaging foodstuffs, using preferably cooled calender rollers, wherein the distance between the centres of a pair of entry rollers is adjustable and one of the two entry rollers is arranged in a bottom frame and the other is arranged in a top frame which is adjustable relative to the bottom frame characterised in that the top frame (2) has a smoothing bar (5), wherein either the upper entry roller (4) or the smoothing bar (5) is associated with the entry roller (3) of the bottom frame (1) in two different operating positions.

2. A calender according to claim 1 characterised in that the top frame (2) has a carriage (6) which is displaceable in a sliding guide (7) of the bottom frame (1).

3. A calender according to claim 1 characterised in that the sliding guide (7) is pivotable on the bottom frame (1) about an axis (8) which is parallel to its entry roller (3).

4. A calender according to one of claims 1 to 3 characterised in that a second calender roller (9) is mounted in the top frame (2) pivotably about a parallel axis.

5. A calender according to one of claims 1 to 4 characterised in that the smoothing bar (5) is suspended pivotably on a swinging frame (10).

6. A calender according to claim 1 or claim 5 characterised in that the smoothing bar (5) has an air outlet nozzle.



7. A calender according to claim 5 or claim 6 characterised in that the smoothing bar (5) is arranged on the swinging frame (10) adjustably in respect of height.



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