United States Patent [19]

Mackie et al.

[11] **3,869,240**

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[54] **PLASTIC FILMS**

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[52] **U.S. Cl.** **425/374,** 425/328, 425/385

[51] **Int. Cl.** **B29c 23/00**

[58] **Field of Search** 425/374, 328, 363, 385

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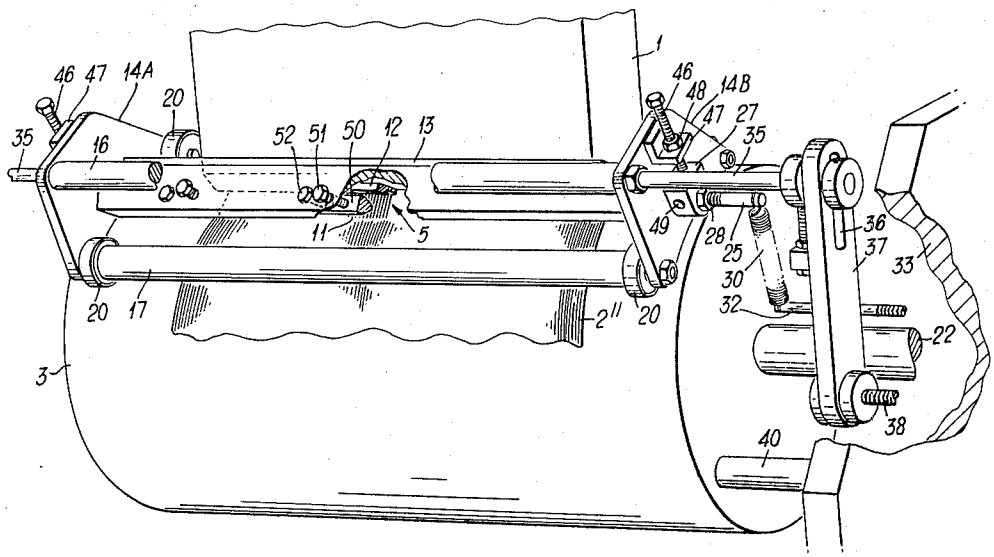
[57] **ABSTRACT**

Apparatus for the profiling of films of synthetic organic polymers comprises a profiling comb and a roller which co-operates with it to form a nip for the passage of film to be profiled, the two members being yieldingly biased together and a spacer is provided which bears against the surface of the roller and is connected to the profiling comb in such a way that any deviations of the roller surface from the concentric react against the spacer so as to produce relative movement between the axis of the roller and the profiling comb and thus maintain the width of the nip between the roller surface and the comb at a predetermined value. The spacer is conveniently in the form of either one or two pairs of low-friction runners, each of which may be in the form of a small, light wheel turning in frictionless bearings. In order to provide adjustment of the nip between the comb and the roller according to the thickness of film and the depth of profiling required, the profiling comb is adjustably mounted within a frame to which the spacer is connected. This frame may comprise a pair of end plates between which the comb is supported and which are interconnected by bars or rods, the end plates carrying two pairs of runners engaging the surface of the roller. The comb may be supported by a bar carried in mountings capable of both linear adjustment towards and away from the roller and also of angular adjustment substantially about the axis of the bar. The comb preferably comprises a number of equally spaced pins extending from a body and arrangements are described whereby the regularity and linearity of the tips of the pins may be adjusted.

16 Claims, 5 Drawing Figures



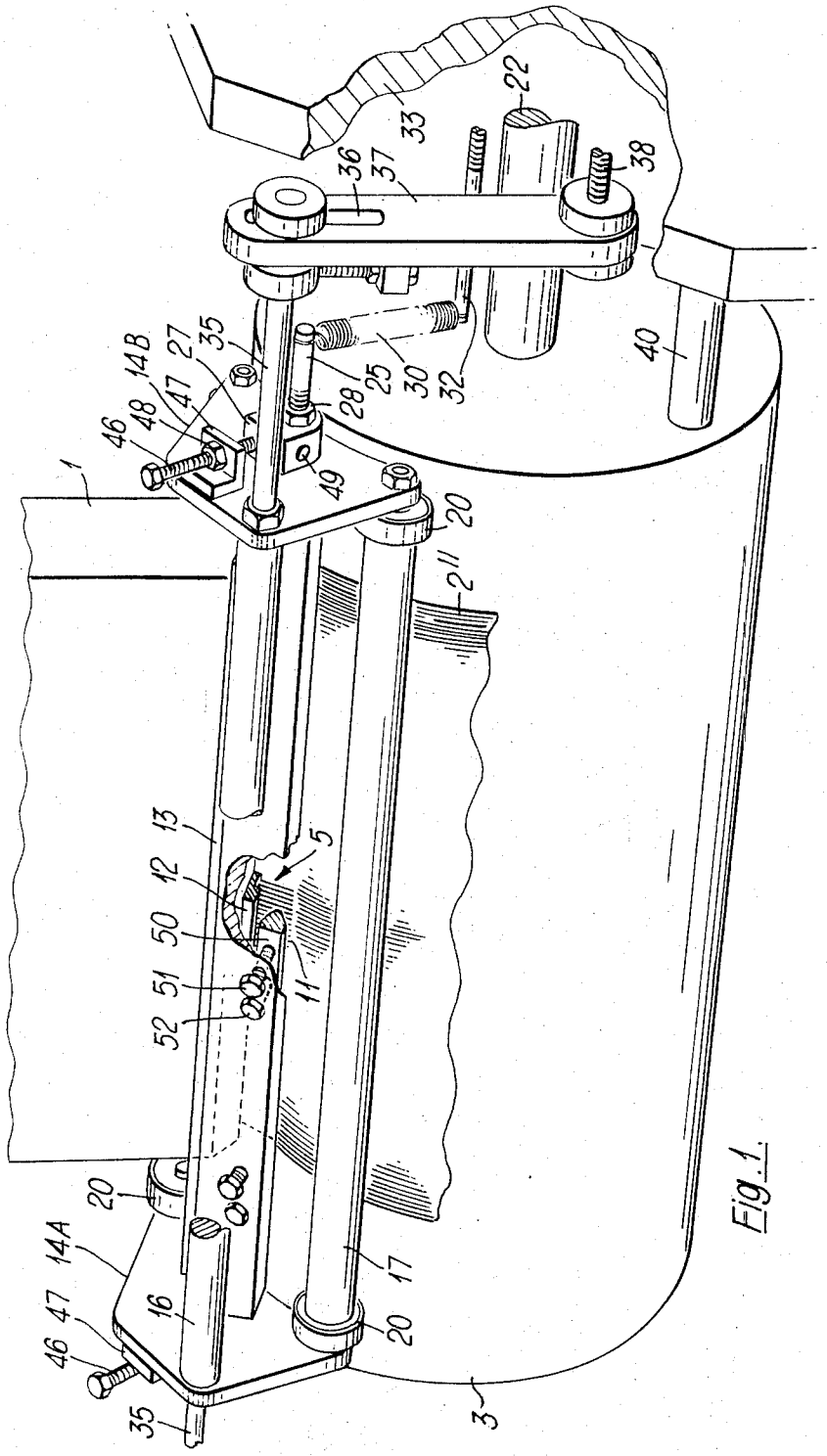

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Fig. 1.

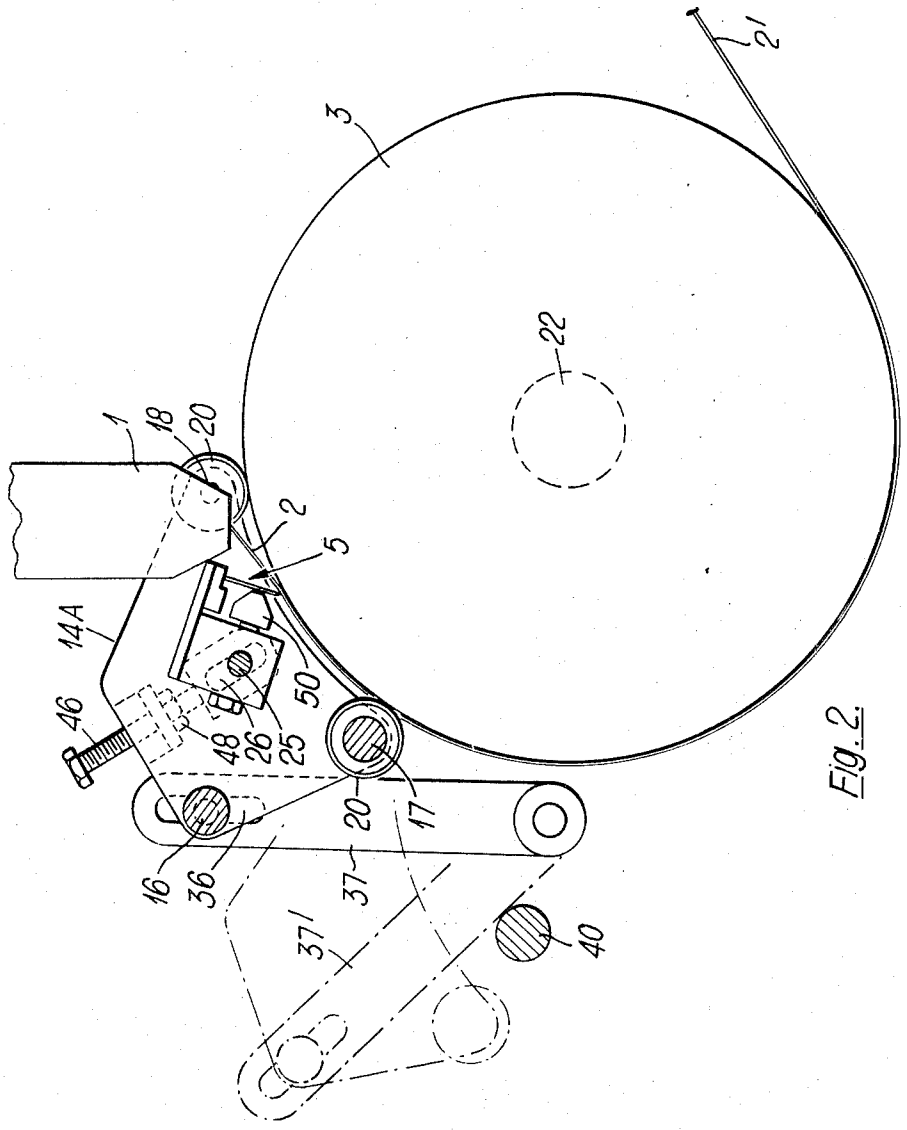

Fig. 2.

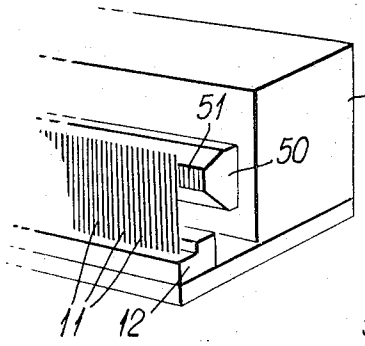

Fig. 3.

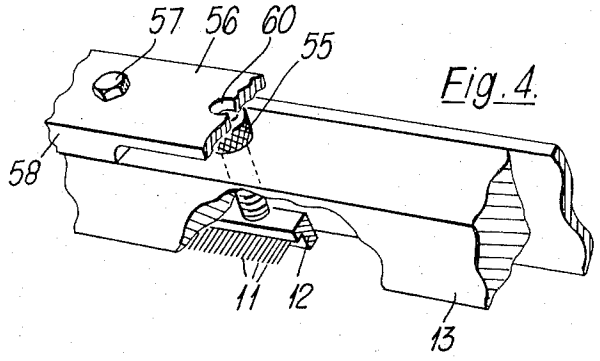

Fig. 4.

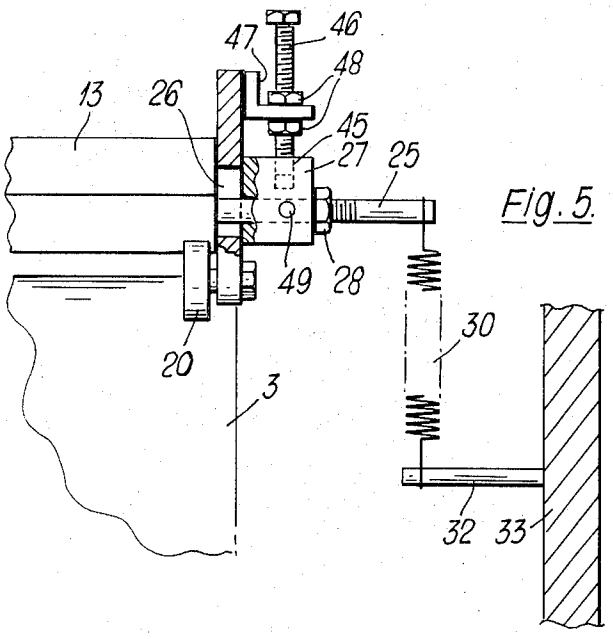

Fig. 5.

PLASTIC FILMS

This invention relates to the fibrillation of films of synthetic organic polymers such as polypropylene or polyethylene, which have previously been stretched to produce longitudinal molecular orientation. Fibrillation is assisted if the film, while in a soft, heated condition, preferably immediately after extrusion, is given a preliminary treatment resulting in a profile consisting of a large number of closely spaced longitudinally-extending parallel grooves separated by intervening peaks. Such grooves define incipient lines of cleavage along which the film will fibrillate much more readily than will an untreated film and which, in some circumstances, will lead to fibrillation without further processing steps. For the purpose of the present specification such treatment is referred to simply as "profiling."

The profiling of the film is achieved by means of a member which may be in the form of a roller whose cylindrical surface is formed with closely-spaced parallel surface ridges, or a static member, for example in the form of a comb comprising one or more rows of needles or the points of a serrated doctor blade. In general, the film to be profiled needs to be passed through a nip between the profiling member and co-operating member and the present invention is concerned with profiling arrangements in which one of the two co-operating members is in the form of a roller and the other is static i.e., does not rotate. In other words, it is concerned with arrangements in which the profiling member is static and the co-operating member is a roller or in which the profiling member is a roller and the co-operating member is static, e.g., in the form of a plain doctor blade.

The film to be profiled may be only a few thousandths of an inch thick and the reduced thickness of film in the region of the profiled grooves is only a small fraction of this so that the two members have to be mounted in relation to one another with extreme accuracy. However great this accuracy may be, errors will still be introduced if the cylindrical surface of the roller is slightly eccentric in relation to its axis of rotation or if there are other irregularities in this cylindrical surface.

According to the present invention, the profiling member and the co-operating member are yieldingly biased together and a spacer which bears against the surface of the roller is connected to the static member in such a way that any deviations of the roller surface from the concentric react against the spacer so as to produce relative movement between the axis of the roller and the static member and thus maintain the width of the nip between the roller surface and the static member at a predetermined value. In other words, the yielding nature of the bias between the two members permits the very small degree of relative movement necessary to allow for irregularities in the cylindrical surface and thus to ensure a substantially constant setting of the static member in relation to the surface of the roller.

Thus if a profiling comb is used in co-operation with a roller, any slight irregularities in the surface of the roller produce very slight relative movement between the comb and the axis of the roller, thus maintaining a uniform setting between the comb and the surface of the roller. The comb will normally be set to leave a small gap between the tips of the pins and the surface

of the roller, but in some cases there may be light contact between the two.

Even then, owing to the resilience of the pins, the film will not be completely shredded but will be extremely thin along the bottoms of the grooves formed by the pins.

Whether the profiling member is constituted by a comb or by a grooved roller, the axis of the roller is preferably fixed and the static member is movably mounted. When using a profiling comb, the co-operating roller may conveniently be constituted by the normal chill roller fitted close to the extrusion die and since, for normal purposes, no particular accuracy is required in this roller, minor eccentricities and other irregularities occur in practice and the effect of these is compensated for by an arrangement in accordance with the invention. With any of the arrangements so far discussed, the two members are preferably biased together by a tension spring.

Quite apart from the need to keep the nip or setting between the two members constant during operation, there is also a need to be able to adjust the nip from one operation to another in accordance with the thickness of the film to be profiled. The necessary adjustment is preferably provided by connecting the spacer to a frame within which the static member is adjustably mounted in a direction towards and away from the roller. The spacer needs to bear accurately against the cylindrical surface of the roller and it is also desirable that friction should be reduced to a small value. Preferably therefore the spacer comprises either one or two pairs of low-friction runners, the runners of a pair being spaced apart in a direction parallel with the axis of the roller. If a single pair of such runners is used, they can be mounted directly in line with the static member, while if two such pairs are used they can be mounted ahead of and behind the line of the static member, the resultant four-point support giving slightly additional stability. Each runner is preferably in the form of a small, light wheel turning in frictionless bearings. As an alternative to the use of such runners, it is possible for the operative surface of the spacer to be constituted by a shoe of low-friction material which bears against the cylindrical surface of the roller over a relatively small arc, e.g. about 30°. Such a shoe is susceptible to wear, however, and even a fraction of a thousandth of an inch is frequently unacceptable in view of the great accuracy required. It is for this reason that the use of the runners referred to above is preferred.

When a frame is used to carry the static member, this preferably comprises a pair of end plates between which the static member is supported and which are interconnected by bars or rods, the end plates carrying two pairs of runners engaging the surface of the roller ahead of and behind the line of the static member as mentioned above. With such an arrangement the static member is conveniently supported by a bar carried in mountings capable of both linear adjustment towards and away from the roller and also of angular adjustment substantially about the axis of the bar.

A construction in accordance with the invention will now be described in more detail, by way of example, with reference to the accompanying drawings, in which;

FIG. 1 is a perspective view of the apparatus arranged immediately adjacent an extrusion die;

FIG. 2 is an end view partly in section corresponding to FIG. 1;

FIGS. 3 and 4 are detailed views showing alternative forms of support for a profiling comb shown in FIGS. 1 and 2; and

FIG. 5 is a detailed elevation, partly in section, of one end of the arrangement seen in FIG. 1.

The apparatus is situated immediately adjacent an extrusion die 1 from which a film 2, best seen in FIG. 2, is extruded onto a chill roller 3, the film passing around approximately one half the circumference of the roller and then leaving towards the right as seen at 2' in FIG. 2. The chill roller 3 forms one of the co-operating members of the profiling apparatus, of which the other co-operating member is a profiling comb indicated generally as 5 in FIGS. 1 and 2 and shown broken away in FIG. 1. This comb engages the film 2 at the point where it comes into engagement with the surface of the roller 3 where it is still in a warm, soft state and produces a rigid profile of the type previously described and as indicated generally at 2'' in FIG. 1. Generally speaking, the film 2 will be only a few thousandths of an inch thick and it is therefore important to maintain an accurate nip or setting between the comb 5 and the surface of the chill roller 3 despite any irregularities in the surface of the latter. It is the manner of achieving this which forms the subject matter of the present invention.

The comb comprises essentially a series of equally spaced pins 11 extending from a body 12 which is supported by a bar 13 of approximately rectangular cross section. This bar is mounted in a frame comprising a pair of similar end plates 14A and 14B interconnected by rods 16 (shown broken away in FIG. 1) and 17 to form a rigid assembly. The end plates 14A and 14B carry runners 20 in the form of light wheels turning on frictionless bearings and engaging the surface of the chill roller 3 so as to maintain a constant spacing between the frame and the roller and hence between the comb 5 and the roller 3. In other words, the presence of any eccentricity or other irregularity in the surface of the roller 3 will cause the frame as a whole to move in relation to the axis of the roller 3, as defined by its shaft 22.

The supporting bar 13 is formed at each end with an extension in the form of a shank 25 which extends through a slot 26 in each end plate and then through a mounting block 27, against which it is locked by a nut 28. The frame comprising the end plates 14A and 14B together with the connecting rods 16 and 17 is biased against the surface of the roller 3 by a tension spring 30 extending from the shank 25 at each end to a stud 32 extending from a plate in which the roller 3 is mounted, part of which is shown as 33. The frame as a whole is carried by studs 35 forming an extension at each end of the rod 16 and each connected to a pivoted arm 37. Provision of an elongated slot 36 in each arm 37 allows relative adjustment of the two ends of the frame at the time of initial setting up, so as to ensure that all four runners 20 are in contact with the surface of the roller 3. Only one of the arms 37 is seen in FIG. 1 and this is pivoted at 38 so as to allow the frame as a whole to be swung from its operating position as shown in FIG. 1 and in full lines in FIG. 2 to the dotted line position shown in FIG. 2 in which each arm 37 comes into engagement with a stop 40. In this position, the comb 5 is swung clear of the roller 3 to provide ready access to the extruder die 1, when necessary.

Each of the mounting blocks 27 by means of which the support bar 13 is carried is formed with a tapped hole 45 into which is screwed a bolt 46 which passes through a hole in a right angle bracket 47 welded to the respective end plate 14. Rotation of the bolt 46 adjusts the position of the mounting block 27, the bolt being held in the adjusted position by means of a pair of lock nuts 48 on either side of the bracket 47. The presence of the slot 26 enables the bar 13 to move with the block 27 and thus to adjust the comb 5 towards and away from the surface of the chill roller 3. In other words, the nip or setting between the comb 5 and the roller 3 can be adjusted in accordance with the thickness of the film to be profiled and the depth of profiling required. Angular adjustments of the comb 5 are obtained by turning the bar 13 and the shank 25 and locking it in the required angular position by means of the nut 28 at each end in conjunction with a lockscrew 49 in the Block 27.

Apart from the bodily adjustments of the comb just described, localised adjustments are also desirable owing to the length and slender nature of the pins 11 making up the comb. In particular there is a risk of the pins taking a slight angled set which would lead to irregular spacing of the tips of the pins along the row. In the arrangement shown in FIGS. 1 to 3, the pins are braced close to their tips by means of a bar 50 extending parallel with the length of the comb and having accurately pitched grooves (shown as 51 in FIG. 3) corresponding to the correct spacing of the pins 11. Each pin is located in a respective groove, thus ensuring an even pitch for the pins while, at the same time, maintaining the advantage of using pins which are long enough to handle without difficulty during manufacture.

Quite apart from the problem of spacing, there is a risk that the body portion 12 of the comb may become slightly distorted so that, even when braced by the bar 50, the points of the pins do not lie precisely in a straight line. For this purpose, a series of uniformly spaced screws is provided which pass through holes in the bar 13, two of these screws being shown as 51 and 52, the remainder of the series being omitted for simplicity. The screw 51 and alternate screws along the length of the comb pass through threaded holes in the support bar 13 and engage the rear of the bracing bar 50 so as to exert a thrust on the bar. The screw 52 and the remainder of the intervening screws pass through plain holes in the support bar 13 and into tapped holes in the bracing bar 50 so that by tightening up an individual screw 52, a pull is exerted on the bracing bar 50. In other words, the screws 51 exert a thrust on the bar 50 and the screws 52 exert a pull on the bar so that, by appropriate adjustment along the length of the bar, any localised distortions can be eliminated.

FIG. 4 shows an alternative arrangement for providing localised adjustment of the body 12 of the comb. In this construction, the pins are shown as being rather shorter and the bracing bar 50 is eliminated. Instead, a series of similar, uniformly spaced screws, one of which is shown as 55 pass through plain holes in the support bar 13 and into tapped holes in the body 12 of the comb. The heads of the screws 55 are trapped between the body of the support bar 13 and a plate 56 which extends along the length of the bar 13 and is fixed to it at intervals by means of bolts 57 extending through locally thickened portions 58 of the plate 56. The screws

55 are socket-headed and the plate 56 is formed with a series of holes 60 in register with the sockets in the screws, for the insertion of a key. Since the head of each screw is trapped so as to be incapable of axial movement, rotation of any one screw in one direction or the other exerts either a thrust or a pull on the body 12 of the comb so as to compensate for any localised distortions.

As a result of the construction just described, the comb in itself can be adjusted so as to be straight and uniform and its position in relation to the chill roller can also be adjusted with considerable accuracy both linearly and angularly. The position of the runners 20 in conjunction with the biasing springs 30 then ensures a uniform setting or nip leading to efficient profiling of the extruded film.

We claim:

1. Apparatus for the profiling of films of synthetic organic polymers comprising a profiling member and a member co-operating with said profiling member to form a nip for the passage of film to be profiled, one of the said members being in the form of a roller having an axis and the other said member being static, means mounting said members in co-operating relationship whereby said members are yieldingly biased together and a spacer member, said spacer member bearing against the surface of said roller and being connected to said static member in such a way that any deviations of said roller surface from the concentric react against said spacer member so as to produce relative movement between said axis of said roller and said static member whereby to maintain the width of said nip between said roller surface and said static member at a predetermined value.

2. Apparatus according to claim 1, in which said static member is a profiling comb.

3. Apparatus according to claim 1, in which said axis of said roller is fixed and said mounting means permits yielding of said static member.

4. Apparatus according to claim 3, in which said roller is constituted by a chill roller of an extrusion die.

5. Apparatus according to claim 3 and including a tension spring for biasing said two members together.

6. Apparatus according to claim 1 and including a frame to which said spacer member is connected and means adjustably mounting said static member for movement towards and away from said roller.

7. Apparatus according to claim 6 in which said spacer member comprises at least one pair of low-friction runners, the runners of said pair being spaced apart in a direction parallel with the axis of said roller.

8. Apparatus according to claim 7, in which each said runner is in the form of a small, light wheel and including frictionless bearings for said wheel.

9. Apparatus for the profiling of films of synthetic organic polymers comprising a profiling comb, a roller having an axis, means mounting said comb and said roller in co-operating relationship to form a nip for the passage of film to be profiled, said mounting means for said comb comprising a frame having a pair of end plates, rods connecting said end plates and means adjustably mounting said comb between said end plates for movement towards and away from said roller, means yieldingly biasing said frame towards said roller and a spacer member, said spacer member bearing against the surface of said roller and being connected to said frame in such a way that any deviations of said roller surface from the concentric react against said spacer member so as to produce relative movement between said axis of said roller and said comb whereby to maintain the width of said nip between said roller surface and said comb at a predetermined value.

10. Apparatus according to claim 9 in which said spacer member comprises at least one pair of low-friction runners, the runners of said pair being spaced apart in a direction parallel with the axis of said roller.

11. Apparatus according to claim 10, in which each said runner is in the form of a small, light wheel and including frictionless bearings for said wheel.

12. Apparatus according to claim 9 including a bar supporting said comb, mountings carrying said bar and means for adjusting said mountings whereby said bar is capable both of linear adjustment towards and away from said roller and also of angular adjustment substantially about the axis of said bar.

13. Apparatus according to claim 9, wherein said comb comprises a body, a plurality of equally spaced pins having tips, said pins extending from said body and a bracing bar having accurately pitched grooves along its length corresponding to the correct spacing of said pins, said bracing bar bearing against said pins close to said tips, whereby said pins are located by said grooves.

14. Apparatus according to claim 13, in which said support bar is formed with a plurality of uniformly spaced holes, alternate holes being plain and tapped, a plurality of screws in said holes, alternate screws engaging said tapped holes and abutting the surface of said bracing bar and intervening screws passing through said plain holes and into tapped holes formed in said bracing bar, whereby said bracing bar is adjustable.

15. Apparatus according to claim 9, wherein said comb comprises a body, a plurality of equally spaced pins extending from said body, said support bar being formed with a plurality of plain holes, a plurality of screws passing through said plain holes and into tapped holes in said body, and a cover plate overlying said screws whereby said screws are trapped between said support bar and said cover plate.

16. Apparatus according to claim 9 and including a bracket whereby said frame is supported for pivotal movement towards and away from said co-operating roller.

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