United States Patent [19]

Bauch

[11] **3,887,972**

[45] **June 10, 1975**

[54] **CRIMPING OF SYNTHETIC PLASTIC FILAMENTS**

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[22] Filed: **July 23, 1973**

[21] Appl. No.: **381,493**

[30] **Foreign Application Priority Data**

July 22, 1972 Germany 2236024

[52] **U.S. Cl.** **28/1.4**

[51] **Int. Cl.** **D02g 1/16**

[58] **Field of Search** 28/1.3, 1.4, 1.6, 1.8, 28/72.11, 72.12, 72.14

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Primary Examiner—Louis K. Rimrodt

Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

A synthetic plastic filament is advanced in plastic condition against a contact surface which travels continuously and which is provided with a groove from which apertures extend outwardly. The filament becomes crimped upon entering into the groove and contacting the walls bounding the same. Cooling fluid is admitted into the groove and is withdrawn from the same through the apertures.

13 Claims, 7 Drawing Figures

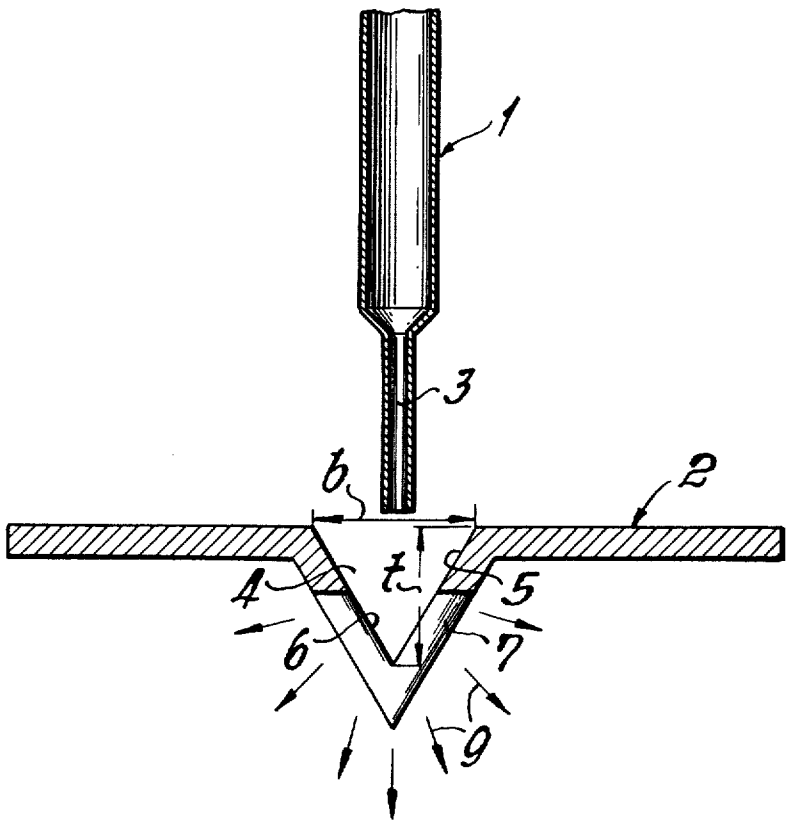

FIG. 1

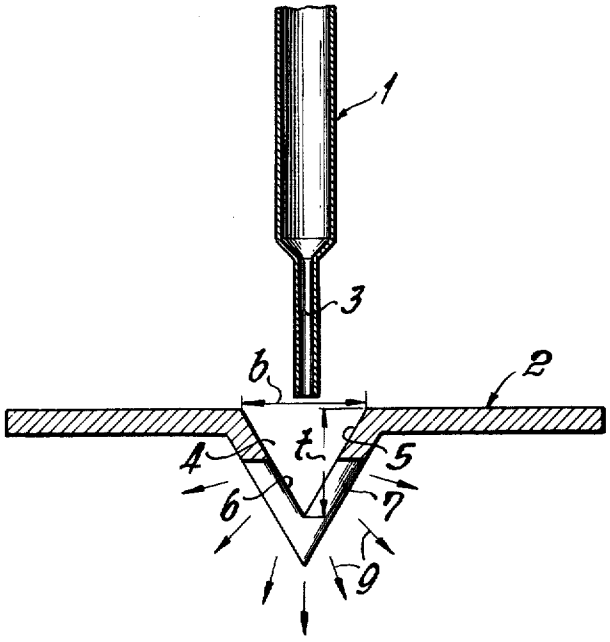

FIG. 2

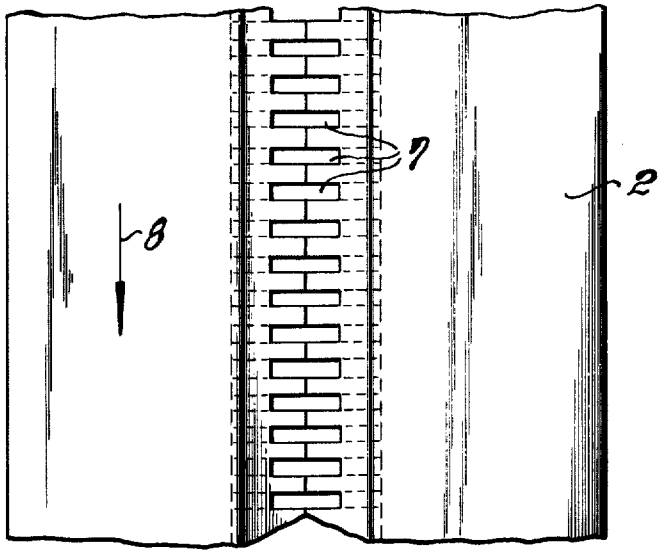

FIG. 3

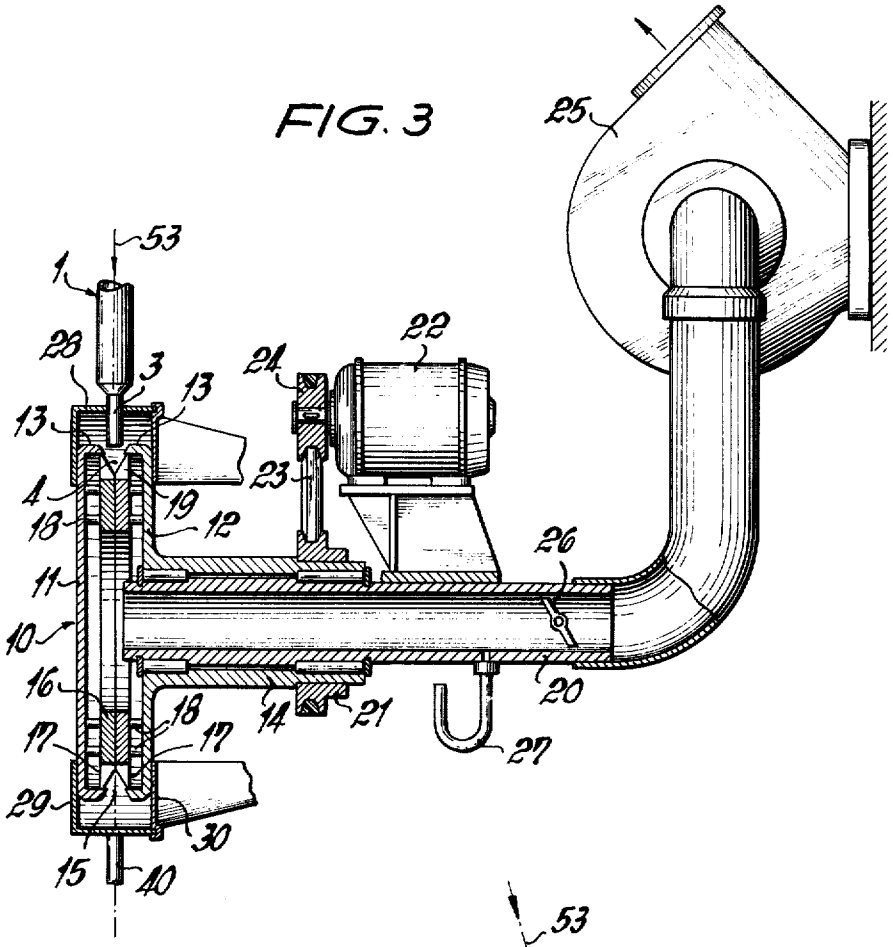
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FIG. 4

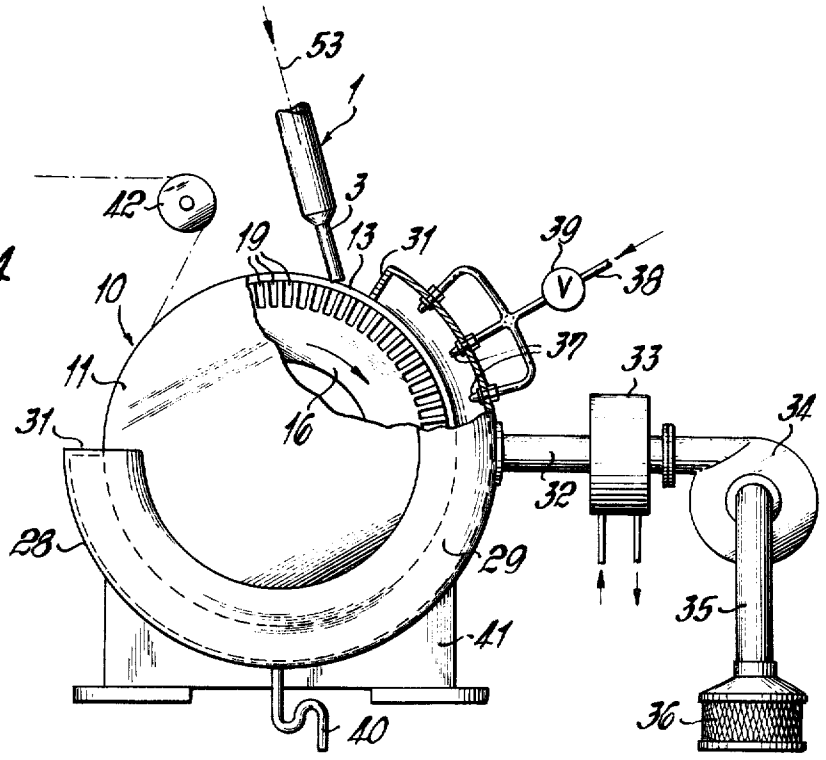
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FIG. 5

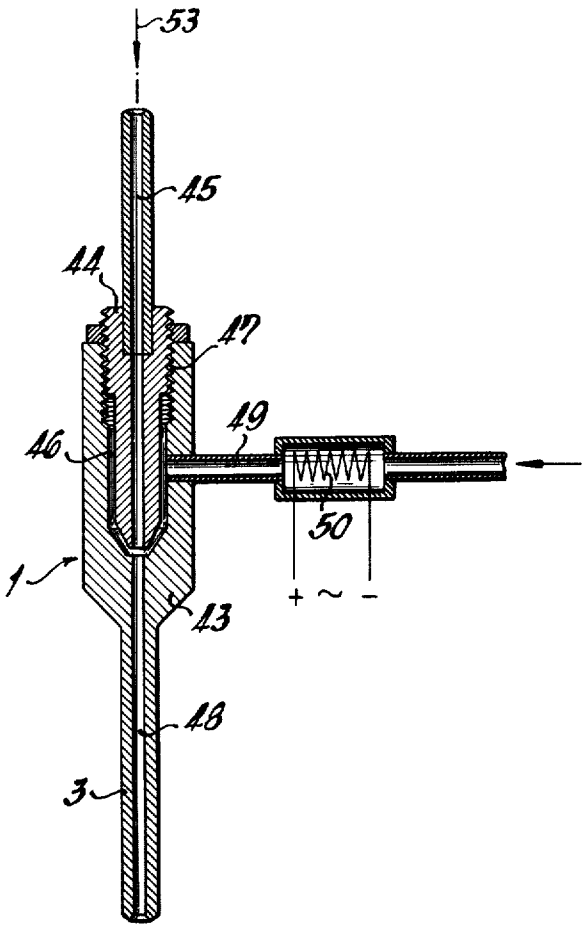

FIG. 7

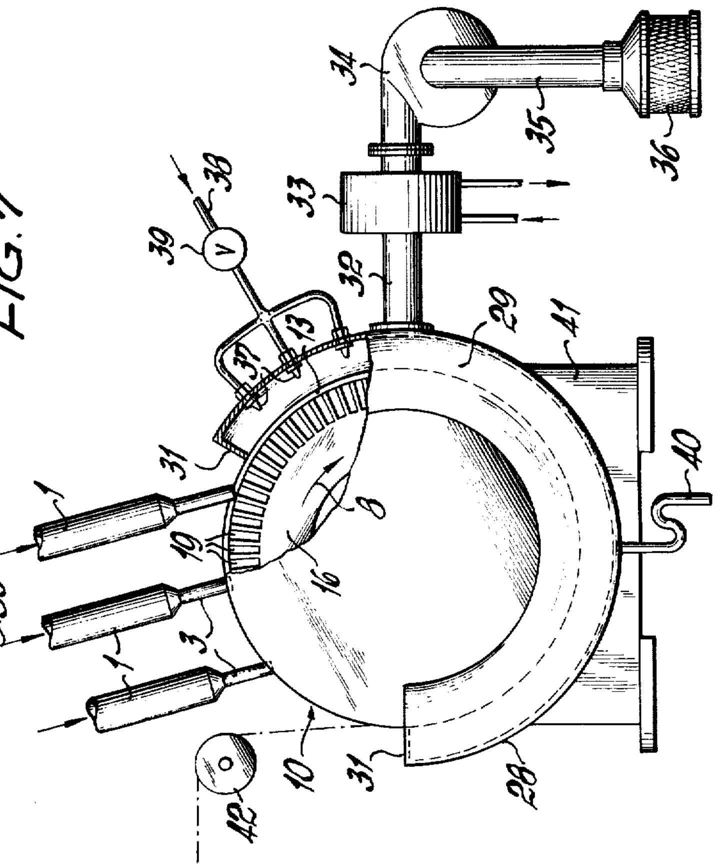
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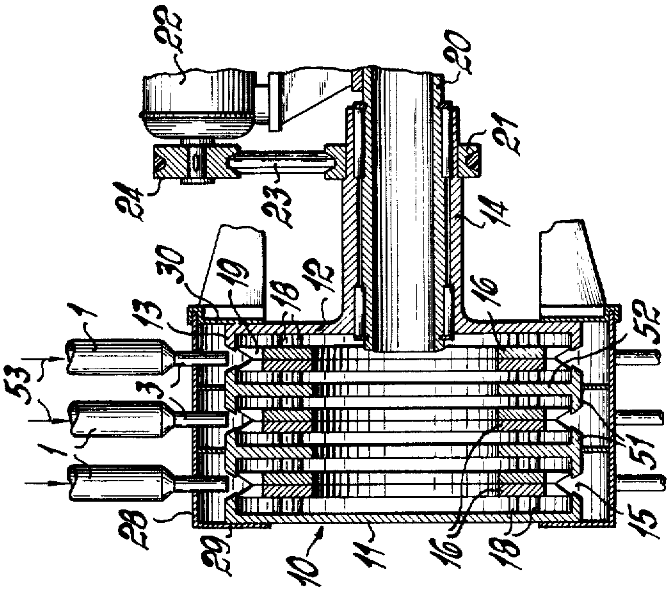
FIG. 6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CRIMPING OF SYNTHETIC PLASTIC FILAMENTS

BACKGROUND OF THE INVENTION

The present invention relates generally to the crimping of synthetic plastic filaments, and more particularly to a method of effecting such crimping and to an apparatus for carrying out the method.

It is already known in the prior art to heat a synthetic plastic filament until it reaches plastic condition, and at the same time to advance it as high speed at an angle against a surface which travels relatively slowly past a nozzle through which the filament is ejected. The filament impacts the surface and becomes crimped thereby. It is taken along for a certain distance by the traveling contact face, the intention being that it should be cooled during such travel, and subsequently it is wound up onto a bobbin or the like. The surface is essentially smooth, but is apertured to permit a rapid withdrawal of the heating medium which issues from the nozzle together with the advancing filament. The surface may be provided on a tightly stretched fabric which is advanced.

Another prior-art construction utilizes a rotating screen drum, the interior of which is connected through its hollow mounting shaft to the suction side of a blower or ventilator. This arrangement serves to cool already crimped filaments, that is filaments which have been crimped in a separate device and are advanced in already crimped condition into the drum. The wall of the drum is proposed to be of a stretched fabric.

SUMMARY OF THE INVENTION

It is a general object of the present invention to provide for the improved crimping of synthetic plastic filaments.

More particularly, it is an object of the present invention to provide an improved method of effecting crimping of synthetic plastic filaments.

Another object is to provide such a method which affords an improved three-dimensional random crimping effect.

An additional object of the invention is to provide an apparatus for carrying out the novel method.

In keeping with the above objects, and others which will become apparent hereafter, one feature of the invention recites, in an apparatus for crimping synthetic plastic filaments, in a combination comprising first means having a surface provided with a groove, and with a plurality of apertures extending from the interior of the groove through the first means. Second means is provided for moving the first means so that the surface travels continuously. Third means directs a synthetic plastic filament in plastic state into the groove substantially normal to the surface, so that the filament becomes crimped in the groove.

The groove is narrow, the term "narrow" being intended to be understood as meaning that the spacing of the lateral walls bounding the groove—at least in the region in which they will be contacted by the filament, that is in the region of the bottom of the groove—will be smaller or at most slightly larger than the diameter of the crimped filament. Extensive tests conducted have shown that the present invention permits a substantial improvement of the texturing effect in synthetic plastic filaments, and although the reasons for the improvement are not entirely clear as yet, it is believed that it results from the fact that during the crimping, the filament is laterally restricted in its freedom of movement by the presence of the walls bounding the groove.

It is advantageous, but not absolutely necessary, if the groove is of substantially wedge-shaped crosssectional configuration. However, depending upon the characteristic of the filament, the groove may also be of rectangular cross section or of trapezoidal cross section. The depth of the groove is advantageously at least substantially equal to its width at the open side of the groove.

The apertures are of small cross section and advantageously configurated as essentially transversely extending slots.

According to a further important aspect of the invention, access is provided for cooling fluid over at least a substantial portion of the length of the groove, and at the side of the first means which faces away from the surface having the groove, there is provided a suction device which withdraws the cooling fluid through the apertures communicating with the groove. This affords a rapid cooling and thus fixing of the crimp in the filament, which takes place while the filament is still lodged in the groove. This not only avoids the possibility that the advantageous three-dimensional crimping structure obtained might be disadvantageously influenced by lateral yielding of the filament or by flattening thereof, but also results in a further improvement in the crimping effect as tests have shown.

The groove may be provided inthe narrow side of a thin element which is subdivided in lamella fashion, at least in the region of the groove, by the aforementioned slots. This element may be accommodated in a housing which, except for a slit affording access to the groove, is otherwise closed everywhere and connected with a suction conduit. It is particularly simple and advantageous if the element is a circular disc or plate, and if the housing is a drum which is fixedly connected with it and is mounted for rotation on a shaft which is hollow and whose interior is connected with the suction conduit.

Two or more such plates may be mounted in one and the same drum, axially spaced from one another. The drum may be surrounded over at least a portion of its circumference by a stationary casing the interior of which is connected with the pressure side of a ventilator. The suction side of the ventilator may have interposed in it a filter, and a cooling device may be located between the ventilator and the casing.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical section through an embodiment of the present invention, shown somewhat diagrammatically and intended primarily for purposes of explanation of the principle of the invention;

FIG. 2 is a top plan view of the contact face having the groove therein, and still being diagrammatic for explanatory purposes;

FIG. 3 is a fragmentary vertical section through a first embodiment of the invention;

FIG. 4 is a partly broken-away perspective, illustrating the embodiment of FIG. 3;

FIG. 5 is an axial section through the thread supplying device of the embodiment in FIGS. 3 and 4;

FIG. 6 is a fragmentary section, illustrating a detail of a further embodiment of the invention; and

FIG. 7 is a perspective, partly broken-away, of the embodiment in FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing the drawing more in detail, and firstly FIGS. 1 and 2 thereof which are intended specifically to illustrate the principle of the invention, it will be seen that reference numeral 1 identifies a thread suppying device which is located above a component having a contact face 2. The device 1 has an outlet nozzle 3 through which a synthetic plastic filament in plastic condition is ejected at relatively high speed. The opening of the nozzle 3 is so directed that it faces into a groove 4 formed in the contact face 2 and having in the illustrated embodiment the cross-sectional configuration of a wedge or an equilateral triangle. The width *b* of the groove 4 at the open side thereof is substantially equal to its depth *t*. For this reason, the lateral surfaces 5 and 6 bounding the groove are relatively steep. The walls of the groove are provided with many small diameter and closely adjacent apertures which may, for instance, have the form of transverse slots 7, as shown in FIG. 2.

In operation of the device, the filament issuing from the nozzle 3 at relatively high speed impacts the groove in the region of the bottom thereof and becomes randomly crimped. Since the contact face advances in the direction of the arrow 8, the crimped filament is taken along in this direction and is cooled by cooling fluid (e.g., air) which is drawn through the slots 7, as indicated by the arrows 9; this results in a fixing of the crimped filament in its crimped state. In keeping with the reduction in the length of the filament which is caused by the crimping operation, the speed at which the contact face 2 is advanced in the direction of the arrow 8 at uniform velocity, is substantially smaller than the speed at which the filament issues from the nozzle 3 of the device 1.

The principle of the present invention will be understood from the above description of FIGS. 1 and 2. Proceeding now to a description of the embodiment illustrated in FIGS. 3–5 it will be seen that a flat drum 10 is provided having end walls 11 and 12. The end wall 11 is configurated as a planar disc having a short cylindrical projection 13, and the end wall 12 differs from it only in that it has a hollow stub shaft 14. Intermediate the two projections 13 of the end walls 11 and 12 there is provided a circumferentially extending slot 15 which exposes a wedge-shaped groove 4 formed in the peripheral edge face of a thin annular disc 16. The thickness of this disc is not much greater in axial direction than the width of the groove 4 and the diameter is just as large as the inner diameter of the projections 13 of the end walls 11 and 12. The edges 17 of the disc 16 at opposite sides of the groove 4 are thus seated in the cylindrical projections 13 and the disc 16 may for instance be connected by means of non-illustrated screws with the end walls 11 and 12 so as to be rigid therewith, being held at appropriate spacing from them by non-illustrated spacing members. The entire circumference of the disc 16 is subdivided in lamella-like fashion by radial slots 19 whose depth, that is their dimension in radial direction, should be at least equal to the depth of the groove 4. In the illustrated embodiment, their depth is slightly greater. The disc can be more readily produced and also cleaned if it is composed of two superimposed thinner discs.

The stub shaft 14 is rotatably journalled on the fixedly mounted suction conduit 20 and provided with a pulley 21, so that the drum 20 can be driven via a motor 22 by means of the belt drive 21, 23, 24 in the direction of the arrow 8 shown in FIG. 4. The suction conduit 20 communicates with the suction side of a ventilator 25, and an adjustable flap 26 can be provided to regulate the suction effect. Reference numeral 27 identifies a discharge conduit for condensation.

Over a large portion of its circumference the drum 10 is surrounded by a stationary casing 28 whose partcircular lateral wall portions 29, 30 are in sealing engagement with the end walls 11 and 12 of the drum 10. Further components serve for sealing the casing 28 which is in communication with a blower 34 via a conduit 32 in which a cooling device 33 of known construction is interposed. A filter 36 is interposed in the suction conduit 35 of the blower 34 so as to remove contaminants from air which is drawn into the blower. Nozzles 37 are provided in the interior of the casing 28 and a conduit 38 communicates with the nozzles 37 so as to permit the latter to receive liquid whose quantity can be regulated by a valve 39. Reference numeral 40 identifies an outlet conduit, reference numeral 41 a frame and reference numeral 42 a reversing roller.

The pneumatic filament supply device 1 which is to be used with the apparatus of FIGS. 3 and 4 has tubular outlet portion 43 and a tubular inlet portion 44. An annular clearance 46 is formed which is closed at the upper end by the threaded connection 47. In the lower region, the bore 48 of the element 43 corresponds approximately to the bore 45 of the element 44. A compressed air conduit 49 communicates laterally with the annular space or clearance 46, and a heating coil 50 is accommodated in the conduit 49. The device 1 is arranged so as to discharge normally or nearly normally into the groove 4.

FIGS. 6 and 7 show a further embodiment of the invention wherein several of the discs 16 are arranged in one and the same drum. Spacing elements 18 are provided in the interior of the drum intermedite the individual discs 16, and cylindrical members 51 are provided at the periphery which are connected with annular discs 52. In keeping with the number of the discs 16, a corresponding number of supply devices is provided. Because of space considerations, the devices 1 are offset relative to one another in FIG. 7. In all other respects, the embodiment of FIGS. 6 and 7 corresponds to that in FIGS. 3–5.

In operation of the novel apparatus, the uncripmed filament 53 is heated in the device 1 and thereby brought into plastic condition as it passes through the same. Because the device 1 is constructed like an injector, the filament is taken along in the device 1 and is blown forcibly into the groove 4, where it will contact the walls of the groove and because of the impacting involved will assume an irregularly crimped condition. The hot gas issuing from the outlet of the device 1 is rapidly withdrawn through the slots 19. The crimped filament in the groove 4 is taken along by the rotating

disc **16**, and because cool air flows around it, its crimped structure is fixed and, in fact, even further improved. As already indicated earlier, it is possible to provide in addition a liquid, such as water or a coloring agent, through the nozzles **37** and to spray this onto the filament. After almost a complete revolution, the crimped filament is withdrawn via the reversing roller **42** and is supplied to a take-up device (not shown).

The apparatus and method according to the present invention provide for a much improved crimping effect. In addition, however, they assure that cooling fluid will pass through the surface having the groove **4** only at those areas where the filament is actually located, namely in the region of the groove. The particular configuration of the groove and the arrangement of the supply of the cooling fluid assures that the cooling fluid will wash over the crimped filament very thoroughly and afford intensive cooling of the filament, so that the latter will be fixed in its crimped condition in a relatively short period of time, so that a high throughput per unit of time can be achieved in the apparatus according to the present invention despite its small dimensions.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the type described above.

While the invention has been illustrated and described as embodied in an apparatus for crimping of synthetic plastic filaments, it is not intended to be limited to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of the prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In an apparatus for crimping synthetic plastic filaments, a combination comprising first means having a surface; second means for moving said first means so that said surface travels continuously; third means for directing a synthetic filament in plastic state in a path substantially normal to said surface, so as to become crimped by contact with said surface; and a groove formed in said surface into which said filament enters so as to be confined against lateral displacement upon contact with the travelling surface, said groove including a plurality of apertures extending from its interior through said first means.

2. A combination as defined in claim **1**, wherein said groove is of wedge-shaped cross-section.

3. A combination as defined in claim **1**, wherein said groove is of rectangular cross-section.

4. A combination as defined in claim **1**, wherein said groove is of trapezoidal cross-section.

5. A combination as defined in claim **1**, wherein said groove has a depth which is at least substantially equal to the width of said groove at the open side thereof.

6. A combination as defined in claim **1**, wherein said apertures are substantially transversely extending slots.

7. A combination as defined in claim **1**, further comprising admitting means for admitting a cooling fluid to said groove over at least a substantial portion of the length thereof; said first means having a side facing away from said surface, and having withdrawing means for said cooling fluid arranged at said side so as to withdraw the cooling fluid through said apertures.

8. A combination as defined in claim **1**, further comprising a housing; a suction device communicating with said housing; and wherein said first means comprises a thin-walled element provided with said groove and being accommodated in said housing, the latter having a gap for enabling access to said groove, and said apertures being slots in said element.

9. A combination as defined in claim **8**, wherein said housing is a rotatable drum having a hollow shaft which is mounted for rotation and communicates with said suction device; and wherein said element is a circular plate mounted in said drum and extending transversely of the axis of rotation thereof.

10. A combination as defined in claim **9**, wherein said first means comprises at least one additional plate similar to the first-mentioned plate and arranged in said drum with axial spacing from said first-mentioned plate.

11. A combination as defined in claim **9**, further comprising a housing surrounding at least a portion of the periphery of said drum, and having an interior communicating with the pressure side of a ventilator.

12. A combination as defined in claim **11**, and further comprising a filter at the suction side of said ventilator.

13. A combination as defined in claim **11**; and further comprising cooling means interposed between said ventilator and said casing.

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