(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 350 450**
A2

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **89810496.3**

(22) Date of filing: **30.06.89**

(51) Int. Cl.[5]: **D 01 D 5/08**
D 01 D 13/00

(30) Priority: **06.07.88 IT 2124388**

(43) Date of publication of application:
10.01.90 Bulletin 90/02

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI NL SE

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(54) **Polychromatic multifilament yarns.**

(57) A method of simultaneously producing at least four continuous polychromatic multifilament yarns consisting of at least four different homochromatic filament groups and comprising at least about 60 continuous filaments by melt spinning from a plurality of spinnerets, air quenching and stretching; the spinnerets are part of a single melt spinning unit and are arranged in at least two mutually distanced vertical planes (P^1, P^2); not more than three different homochromatic groups of filaments of any yarn are extruded from the spinnerets arranged in the same vertical plane.

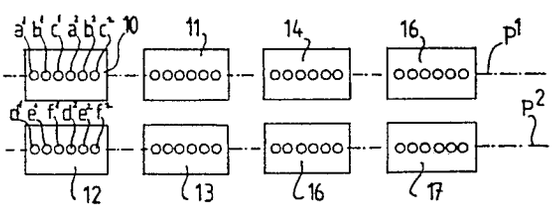

FIG. 1

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Description

POLYCHROMATIC MULTIFILAMENT YARNS

(1) Field of the Invention

The present invention relates to the production of colored, preferably bulked continuous multifilament yarns by melt spinning.

(2) Description of the Prior Art

It is well known in yarn producing technology, e.g. as disclosed in GB 2,098,536, EP 0 028 844 and DE 3,232,202, to produce multifilament yarns by melt spinning methods wherein a molten mass of a suitable polymer such as polyester, polyamide or polyolefin, optionally with added dye or pigment and conventional additives, is extruded via one or more spinnerets into a cooling chamber for air quenching and wherein the solidified extrudate is oriented by drawing to a textile denier or titre and subjected to at least one texturizing or bulking step prior to winding up or other type of processing operation.

A substantial percentage of the bulked continuous filament (abbreviated as BCF) yarns so produced is used for the manufacture of carpets and similar types of covering materials where a vividly or characteristically colored appearance is desirable and is obtained by assembling the final bulked or unbulked yarn from a number of filament groups, strands or yarn components consisting each of filaments of one and the same color (termed "monocolored" or "homochromatic" herein), while the filament groups have mutually differing hues or colors so that the final assembled yarn consists of filaments of two, three or more different colors and is termed "multicolored" or "polychromatic" herein.

According to applicant's best knowledge, however, prior art melt spinning plants have not been capable of simultaneously producing multicolored yarns composed of more than three differing homochromatic yarn components. In fact, if yarns composed of more than three homochromatic strands were to be made in conventional plants, one had to take recourse to the detour of producing four or more differing homochromatic yarn components on separate plants, winding up the homochromatic strands and producing the multicolored yarns in a special intermingling plant.

Accordingly, polychromatic yarns composed of four, five or even six differing homochromatic yarn constituents tend to be substantially more expensive than those of three or less homochromatic constituents.

OBJECTS AND SUMMARY OF THE INVENTION

Therefor, it is a main object of the invention to provide for a method that is capable of economically producing, in a single production step or plant, a number of continuous and preferably bulked continuous polychromatic yarns each of which is composed of four or more differing homochromatic yarn constituents.

Another object of the invention is an apparatus for use in such a method.

It has been found according to the present invention that the above objects and further advantages will be achieved by a method of simultaneously producing at least four, and preferaby eight, continuous polychromatic and preferably bulked multifilament yarns, each yarn, in turn, consisting of at least four and preferably six differing homochromatic fila ment groups and comprising at least about 60 and preferably at least about 120, e.g. 240, continuous filaments by melt spinning from a plurality of spinnerets; the method according to the invention is characterized in that the spinnerets are arranged in at least two mutually distanced vertical planes and in that not more than three different homochromatic groups of filaments of any one yarn are extruded from spinnerets arranged in the same vertical plane.

Further, it is frequently preferred that not more than three spinnerets for extrusion of different homochromatic filament groups are provided each in the first and in the second vertical plane.

While the method of the invention can be used for production of yarns from any polymer composition suitable for melt spinning processing, polyolefins are a preferred group and polypropylene is a particularly preferred species. Examples of suitable polymers of this type and melt spinning conditions suitable for them are disclosed, for example, in European Patent Application No. 87810568.3 (published after the priority date of the present application) and the patent literature cited therein.

According to a further embodiment, the invention provides a novel apparatus for carrying out the inventive method just defined; this melt spinning apparatus according to the invention includes means for simultaneously producing at least four and preferably at least eight continuous polychromatic multifilament yarns, each yarn being composed of a number of different homochromatic filament groups; the apparatus comprises a number of extruders (e.g. four, five or six) to provide at least one extruder for each of the differing homochromatic filament groups; at least one spinneret for each homochromatic yarn constituent; conduit means, e.g. manifolds and spinning pumps, for operationally connecting each spinneret with one extruder; cooling or quenching chamber means; assembling means for combining a number of yarn constituents to form a polychromatic yarn strand; and yarn strand withdrawal means.

The apparatus according to the invention is characterized in that the spinnerets are arranged in at least two different spinneret groups; that each spinneret group is substantially defined by a common vertical plane of alignment; that each of the combined means is supplied from spinnerets of both spinneret groups; and that not more than three spinnerets for any given yarn are arranged in one common plane.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be explained in more detail with reference to the annexed drawings which are not intended to limit the invention and in which:

Fig. 1 is a diagrammatic top view of the extrusion side of a spinneret arrangement according to the invention for producing a total of eight polychromatic yarns, each containing six differing homochromatic yarn constituents;

Figs. 2A, 2B and 2C are semi-diagrammatic views of a plant according to the invention for producing eight polychromatic yarns, each consisting of six homochromatic filament groups, and

Figs. 3A and 3B are diagrammatic views of a novel filament deflector for use in feeding out extrudate filaments at the lower end of the quenching chamber in a preferred apparatus according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Specifically, the diagrammatic illustration of Fig. 1 shows the extruding ends of four pairs 10, 12; 11, 13; 14, 16; 15, 17 of spinneret groups defined by and aligned in parallel and substantially vertical planes P^1 and P^2 indicated in dash-pointed lines. As shown explicitly only for the first pair 10, 12, the first spinneret group 10 includes two sub-groups a^1, b^1, c^1 and a^2, b^2, c^2 of spinnerets corresponding, for example, with a first set of filaments of three differing colors (colors a, b and c) while the second spinneret group 12 includes two sub-groups d^1, e^1, f^1 and d^2, e^2 f^2 corresponding, for example, with a second set of three differing colors (colors d, e and f). Each of the six spinnerets of each group 10-17 of Fig. 1 includes at least about 15 openings (not shown) in a generally regular and preferably circular array for extruding 15 (or more) filaments from each spinneret (represented by a circle in Fig. 1). The 15 (or more) filaments that are extruded from a single spinneret are said to form one "group".

As is apparent from the side view of a plant according to the invention shown in Fig. 2A, the extruded filaments are collected at the lower end of quenching chutes 241, 242. There, a first yarn 1 composed of filament from spinnerets a^1, b^1, c^1, d^1, e^1, f^1 and a second yarn 2 composed of filament from spinnerets a^2, b^2, c^2, d^2, e^2, f^2 are assembled. In an analogous manner, yarns 3-8 are assembled from corresponding a/b/c and d/e/f constituents. If a yarn is formed of filaments emanating from 6 different spinnerets and if the yarn is to comprise only 4 or 5 differing colors, one or two spinnerets will produce filaments that are uncolored or have the same color as those from one of the other spinnerets. Generally, the plant illustrated in Figs. 2A, 2B and 2C includes 6 extruders 21 with subsequent spinning units 22 in which the spinnerets are arranged in two distanced planes P^1 and P^2. The extruded filaments are quenched in quenching units 24 having parallel chambers 241, 242 supplied with cooled air via conduit 25 and are fed out via deflectors 26 into a conventional stretching device 27 for a molecular orientation. Power supply and automated control units are arranged at 29 and a control panel 291 provides for manual control and settings. Stretching in a device 27 including friction rollers that operate at differential speeds, as well as passage through a texturing device 271 and final winding of the assembled yarns 1-8 in pairs on winding mandrel 28 is apparent from Fig. 2B but does not require a detailed explanation because such arrangements are well known in the art.

An essential difference of the new apparatus according to the invention and comparable prior art plants is best apparent from the top view shown in Fig. 2C since it shows the actual arrangement of the spinnerets in mutually distanced planes P^1 and P^2 in the manner explained diagrammatically in connection with Fig. 1.

A preferred filament deflector device for use in the assembly means 26 (Fig. 2A) is illustrated in a diagrammatic front view in Fig. 3A and in a side view in Fig. 3B. A pair of end plates 31, 32 supports two elongated rods or bars 33, 34 and provides a pair of circular grooves 311, 321 for slindingly guiding a half-cylindrical shield 38 which may be provided with a number of shallow grooves on the outside of shield 38. Lower bar 34 supports a number of filament guides 35 made of a ceramic or the like resistant material. Each guide is provided with a small hole (not shown) through which a spinning oil can be supplied from a conduit 37 and through a number of connector tubes 371. For starting up, the shield 38 is moved into a position in which it covers the filament guides 35 so that the start-up filaments run on the outer side of shield 38. Upon commencement of regular operation, shield 38 is moved to uncover filament guides 35 so that the filaments will be drawn into the guides and supplied with spinning oil.

Circular and mutually exchangeable spinnerets (same diameters) are preferred for the inventive method and apparatus; typically, a spinneret will have 20, 30 or more openings to produce filaments with a denier in the range of from about 1 to 15 den per filament to obtain yarns in a denier range of from about 40 to about 800 den (yarn total).

Typical polychromatic yarns made according to the invention include four, five or six different monochromatic yarns, e.g. red/blue/black/white, red/blue/yellow/black/white and red/indigo/yellow/black/white/light blue, etc. Use of more than six colors in a polychromatic multifilament yarn does not normally provide additional benefits. Polychromatic yarns consisting of four or five differing homochromatic filaments are generally preferred.

A "common plane" or "plane of alignment" of spinnerets is generally assumed herein to be an essentially flat, i.e. not curved vertical plane; preferably, at least three spinnerets should be aligned such that the vertical lines through the geometric centers of each of these three spinnerets are essentially situated in such a common plane.

Various modifications of the method and apparatus disclosed herein within the scope of the present invention will be apparent to those experienced in the melt spinning art.

While there are shown and described preferred embodiments, it is distinctly understood that the

invention is not limited thereto, but may be otherwise variously embodied and practiced within the scope of the following claims.

Claims

1. A method of simultaneously producing at least four continuous polychromatic multifilament yarns, each yarn consisting of at least four different homochromatic filament groups and comprising at least about sixty continuous filaments, by melt spinning from a plurality of spinnerets, air quenching and stretching; said spinnerets being arranged in at least two mutually distanced vertical planes; and not more than three different homochromatic groups of filaments of any yarn being extruded from the spinnerets arranged in a common vertical plane.

2. The method of claim 1 wherein each yarn is formed of six groups of filaments of which at least four are homochromatic each but of mutually different colors.

3. The method of claim 1 wherein said yarn is formed of four or five different homochromatic filament groups.

4. The method of any of claims 1-3 wherein a first portion of said plurality of spinnerets is substantially aligned in a first vertical plane while a second portion of said plurality of spinnerets is substantially aligned in a second vertical plane.

5. The method of claim 4 wherein not more than three spinnerets for extrusion of different homochromatic filament groups are provided in said first and said second vertical plane.

6. A melt spinning apparatus for simultaneously producing at least four and preferably at least eight continuous polychromatic multifilament yarns, each yarn comprising a number of different homochromatic filament groups, said apparatus comprising:

(A) a number of extruders to provide at least one extruder for each of said different homochromatic filament groups.

(B) at least one spinneret for each of said homochromatic filament groups; said spinnerets being arranged in at least two different groups; each of said spinneret groups being substantially defined by a common vertical plane of alignment, and each of said combining means being supplied from spinnerets of both of said at least two different planes but not more than three spinnerets from one common plane;

(C) conduit means for connecting each of said spinnerets with one of said extruders;

(D) cooling chamber means;

(E) assembly means for combining a number of said filament groups to form a polychromatic yarn strand; and

(F) yarn strand withdrawal means.

7. The apparatus of claim 6 comprising stretching and texturizing means arranged downstream of said assembly means and wherein said spinnerets are circular.

8. The apparatus of claim 6 wherein said assembly means include at least one filament deflector device comprising a slideable shield having a first operative position for guiding said filaments upon start up, said device further including a number of fixed filament guides that are covered by said slideable shield and are operative for filament guiding when said shield is in said second positon.

9. The apparatus of claim 8 wherein said shields have an essentially semi-cylindrical shape and are slidingly held between a pair of end plates.

10. The apparatus of claim 8 wherein said fixed filament guides are connected to a source of spinning oil.

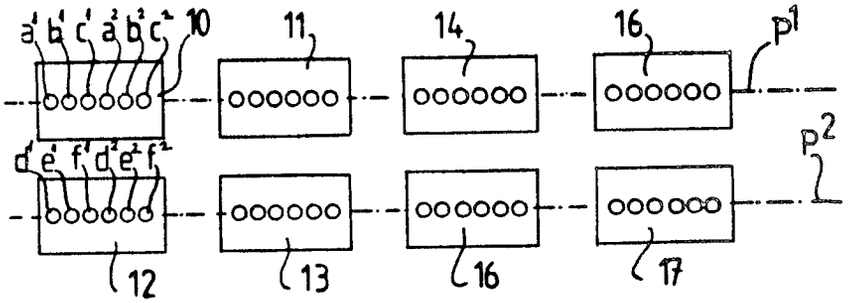


FIG. 1

FIG. 2A

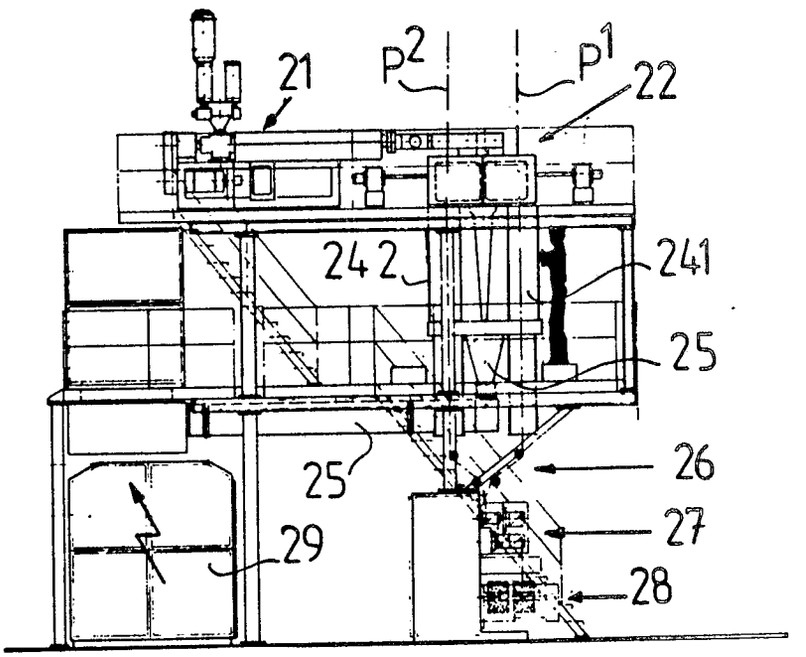


FIG. 2B

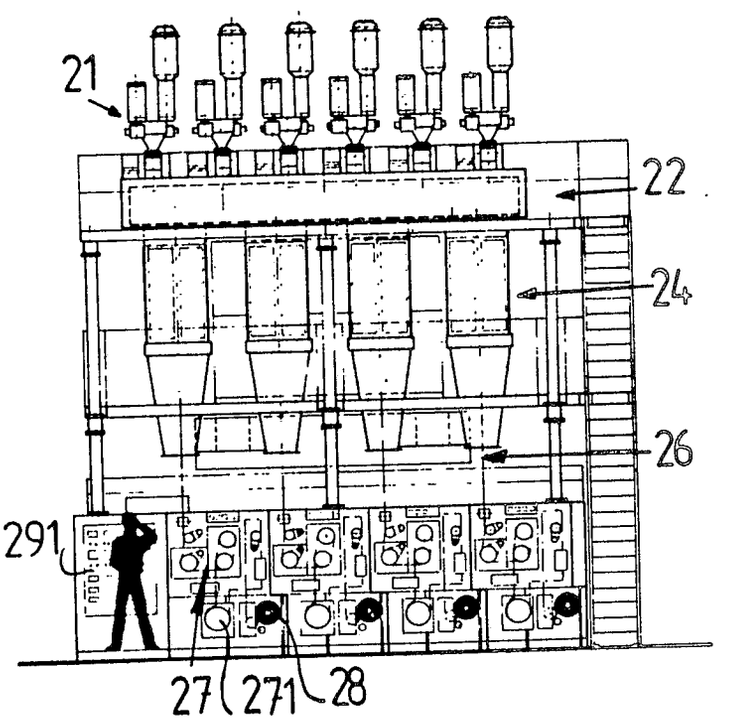
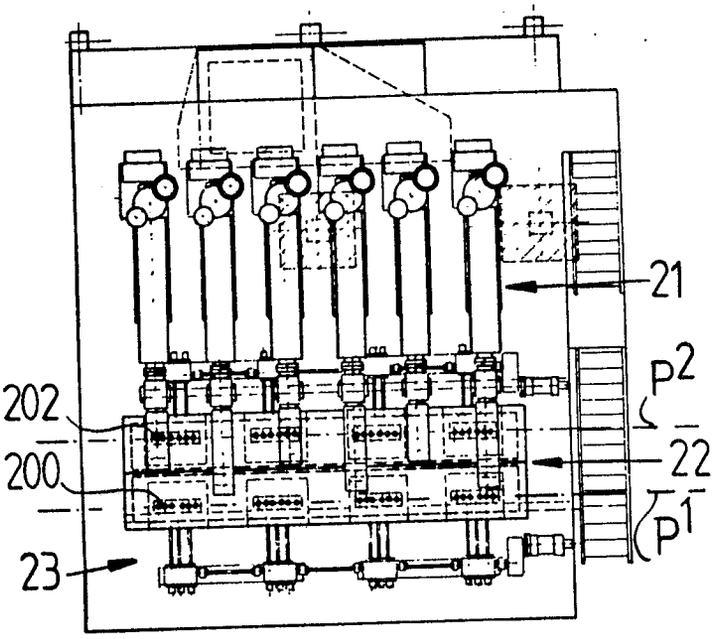


FIG. 2C



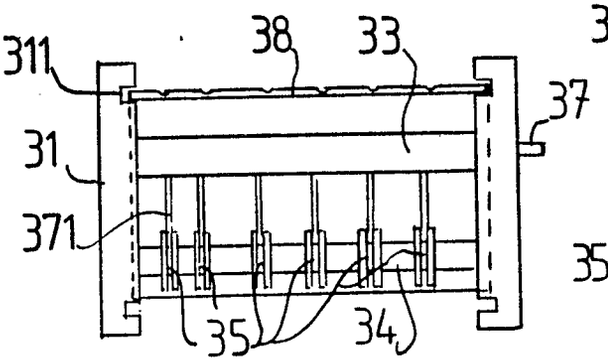


FIG. 3A

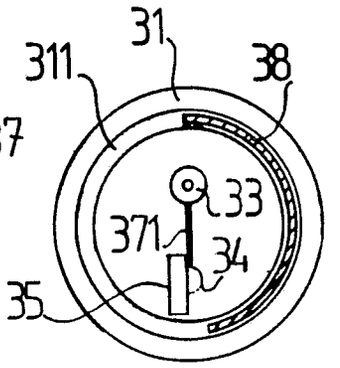


FIG. 3B