

Aug. 21, 1962

J. OGDEN ET AL

3,049,753

SPINNERETTE

Filed April 29, 1959

FIG. 1

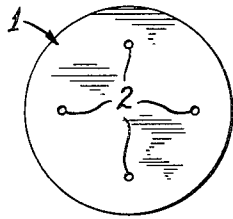


FIG. 2

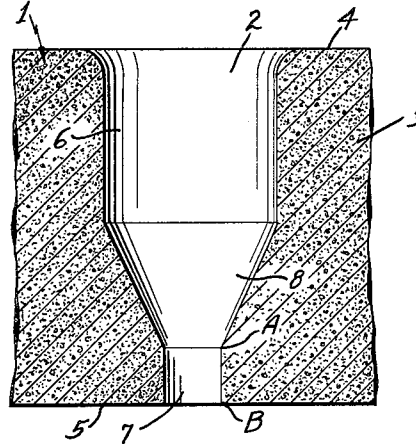


FIG. 3

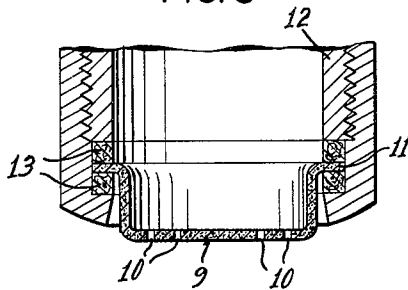


FIG. 4

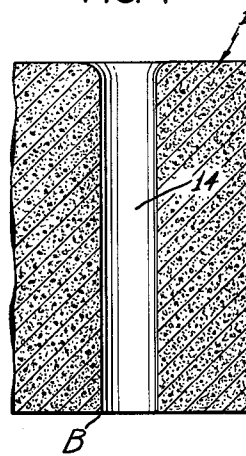
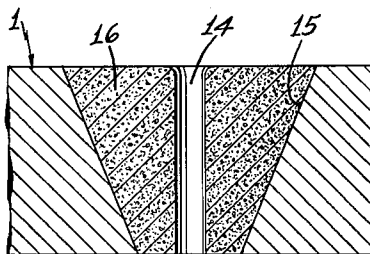


FIG. 5



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1

3,049,753

SPINNERETTE

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Filed Apr. 29, 1959, Ser. No. 809,742

8 Claims. (Cl. 18—8)

The present invention deals with a spinnerette for the extrusion of viscous synthetic substances of filament forming ability, and is concerned in particular with a spinnerette composition especially suitable therefor.

This application is a continuation-in-part of application Serial No. 688,228, filed October 4, 1957, and now abandoned.

Spinnerettes for the extrusion of viscous substances in the spinning of artificial filaments, e.g. nylon, rayon, etc., usually comprise a plate in the form of a disc or cup, or the like, provided with a plurality of orifices formed therethrough and through which the viscous mass is extruded to form filaments.

In the spinning of certain artificial filaments, spinnerettes composed of base metals such as nickel, nickel alloys, and stainless steels, have been found suitable. However, such spinnerettes are not always satisfactory under severe operating conditions and are in particular not especially suitable in the spinning of artificial filaments of synthetic polyamides and other polymerization products or fibre forming ability where spinning takes place at elevated temperatures and under otherwise exacting operating conditions resulting from the nature of the extrusion mass. Although spinnerettes of stainless steel have been found suitable where thick-walled spinnerettes are employed, e.g. in the nylon process, the spinnerettes have not been entirely free from undesirable wear and corrosion. It is a critical requirement that the walls of the orifices and especially capillary discharge orifices are smooth and that the discharge opening is in the form of a sharply defined edge in the plane of the spinnerette bottom. When such sharp edge becomes rounded or otherwise worn due to oxidation or corrosion under the influence of the high temperatures attendant with extrusion of heated synthetic viscous masses, the spinnerette must be discarded and scrapped because the filaments no longer are uniformly extruded.

Furthermore, the polished surface of the orifice walls and the sharp contour of the outlet orifice edge are subjected to the abrasive action of certain types of treated yarns, especially those known as dull yarns, and may otherwise be deleteriously affected by the cleaning processes at even higher temperatures, whereby the life of the spinnerette becomes limited or otherwise abnormally decreased.

It is an object of the present invention to provide a spinnerette characterized by a longer life under adverse spinning conditions than that of spinnerettes heretofore known. It is another object of the present invention to provide a spinnerette which shall be suitable for the spinning of artificial filament and the like from synthetic materials under substantial extrusion pressures. It is a further object of the present invention to provide a spinnerette which is resistant to abrasion and substantially free from corrosion, erosion and oxidation at elevated temperatures, and especially substantially free from such corrosion, erosion and oxidation at critical portions of the extrusion orifice. Other objects and advantages of the invention will appear from the description hereinafter following and the drawings forming a part hereof, in which:

FIGURE 1 illustrates a top plan view of one type of spinnerette,

2

FIGURE 2 is a fragmentary enlarged vertical sectional view through the spinnerette wall,

FIGURE 3 is a transverse vertical sectional view through an extrusion apparatus including another type of spinnerette,

FIGURE 4 is a fragmentary enlarged vertical sectional view through a spinnerette wall having a modified form of orifice formed therethrough, and

FIGURE 5 illustrates a fragmentary sectional view of another modification of the invention.

According to the present invention, there is provided a spinnerette composed of a sintered metal compact containing essentially a finely powdered carbide of tungsten mixed with a finely powdered platinum group metal as a binder, said compact being in the shape of a plate or cup having a plurality of spinning orifices formed therethrough, whereby the particular spinnerette composition is not only resistant to corrosion and oxidation, but preserves and maintains the sharply defined edges of the spinnerette orifices in the plane of the extrusion face of the spinnerette, which would otherwise flake or erode particularly as a result of abrasion and corrosion conditions under the influence of high temperatures and pressures to which the viscous spinning mass is subjected.

In the manufacture of the spinnerette, finely divided tungsten carbide is mixed with one or more of the platinum group metals in finely divided form, pressed in a suitable die, e.g. a cup-shaped die or disc, and sintered, preferably in a reducing atmosphere, until the mixture is intimately bonded by virtue of the ability of the platinum group metals to form a strong bond with the tungsten carbide. Thereafter, the blank compact is subjected to orifice drilling operations such as by diamond lapping drilling, ultrasonic drilling or electrical arc drilling, which are known drilling methods.

The metal composition herein contemplated ranges from 80% to 99% tungsten carbide and from 1% to 20% platinum group metal.

One suitable composition consists of 5% platinum, the rest tungsten carbide.

Another suitable composition consists of 15% platinum, the rest tungsten carbide.

One or more of the platinum group metals may be substituted for the platinum.

The utilization of the composition hereinabove set forth for spinnerettes results in an extremely long spinnerette life even under the most adverse spinning conditions since the platinum group metal binder is resistant to corrosion and maintains its bond function under a wide range of elevated temperatures and under corrosive conditions at high temperatures, while the tungsten carbide provides for the high hardness and smoothness especially desirable for spinnerettes in addition to its corrosion resistance.

Attempts were made to use a spinnerette made of a conventional tungsten carbide composition which normally employs cobalt as a binder, but it was found that such conventional tungsten carbide composition deteriorated in use due to the corrosion of the cobalt, which rendered the composition entirely unsatisfactory for use under spinning conditions.

Regarding the drawing, FIGURE 1 illustrates a spinnerette in the form of an extrusion plate or disc 1, constructed in accordance with the invention, and which is provided with extrusion orifices 2.

Other types of spinnerettes to which the invention is applicable may be in the form of cups, or cups and discs having insert members positioned therein with the insert members each having a single orifice 2 formed therethrough and with the inserts formed of the material of the invention.

The number of extrusion orifices in the spinnerette

3

ranges from 5 to 500 depending on the number of such orifices as are required. The plate, disc, cup or insert of the material through which an orifice or orifices 2 are formed has a thickness of from about 0.125 inch to about 1.0 inch.

FIGURE 2 shows a particular form of orifice through the thickness of the spinnerette plate 1, which is in the form of a plate composed of the sintered tungsten carbide-platinum group metal composition 3, which is provided with an inlet face 4 having inlet portions of the orifice 2 formed therethrough, which is provided with an outlet face 5 having outlet portions of the orifice formed therethrough and terminating in the plane of the outlet face.

In the particular orifice of FIGURE 2, the orifice comprises a cylindrical inlet 6, a cylindrical outlet 7 of less diameter than said cylindrical inlet and known as the spinnerette orifice capillary bore, and a tapered intermediate portion 8 connecting said inlet and outlet.

FIGURE 3 shows a cup-shaped type of spinnerette according to the present invention as applied to an extrusion apparatus.

The cup-shaped body 9 of the composition 3 as hereinabove described, is provided with a plurality of extrusion orifices 10. The spinnerette may be attached to the extrusion apparatus in well-known manner, e.g. by means of the flange 11 at the end of an extrusion tube or pipe 12 between gaskets 13.

FIGURE 4 illustrates a modified form of spinnerette orifice formed through the plate 1 or cup-shaped body 9. The modified orifice is in the form of a cylindrical capillary bore 14 formed through the thickness of the spinnerette.

FIGURE 5 illustrates another modification of the invention wherein the spinnerette plate 1 is composed of stainless steel or other metal or alloy wherein the orifices 2 are replaced by comparatively large apertures 15 formed therethrough and with inserts 16 nested in the apertures, the inserts being composed of the material of the invention.

The cylindrical outlets or capillary bores 7 and 14 have a diameter of from about 0.003 inch to about 0.0625 inch, with the length thereof being from about .005 inch to about 1.0 inch depending upon the type of orifice employed, e.g. an orifice of the type according to FIGURE 2 or of the type shown by FIGURES 4 and 5.

With spinnerette orifices within the dimension ranges above set forth, certain critical conditions determine the quality of the spinnerette orifice walls and consequently the quality of the filaments extruded through such orifices. These conditions require that the walls of the orifice be smooth and that critical portions of the orifice have a sharply defined and absolutely uniform cross-sectional contour. The critical portions of the spinnerette orifice are indicated at locations A and B in FIGURE 2 and at B in FIGURE 4.

In the case of spinnerettes composed of stainless steels, for which the spinnerette of the invention is an improvement, the critical portions A of the orifice are apt to develop small burrs during the drilling operation. While not every orifice will develop such burrs, it is difficult to control the metal so that every orifice in a spinnerette having a plurality of orifices is free of such burrs. The greater the number of orifices, the greater the difficulty of providing uniformity among the orifices. Once a burr is formed at a location A, a removal thereof provides a small chamfer which destroys the uniformity of the orifice in comparison with the other orifices. When the burr is present, there is a disturbance of flow of the extruding mass which deleteriously affects the extruded filament. When the burr is removed, the chamfer created by the removal alters the length of the capillary bore which affects the pressure drop of the extruding mass and provides a non-uniform filament in comparison with filaments extruded through other orifices in the spinnerette plate. Non-uniformity of the filaments results in variation in

4

denier which in turn varies the dyeing qualities and strength of the filaments.

Consequently, such conditions in spinnerette orifices of the dimension ranges described critically affect the extruded filaments, and it is essential that all the orifice walls and all the sharply defined orifice outlets in the plane of the extrusion face be dimensionally uniform throughout the spinnerette plate.

With the material of the invention, its composition nature is such that burrs do not occur during the orifice-forming operations and all the cross-sectional portions of the orifice and the outlet edges are sharply defined and are of uniform dimensions.

As stated above, the conditions described may not be critical with orifices having dimensions outside the scope of the ranges set forth, but such conditions are definitely critical within the orifice dimensions of the invention.

It is apparent that the extrusion apparatus shown is merely illustrative of one mode of application for the spinnerette of this invention, other extrusion apparatus being, of course, applicable within the scope of the appended claims.

What is claimed is:

1. A spinnerette comprising a plate portion having an inlet face and an outlet face, a plurality of extrusion orifices passing through the thickness of the plate, the material defining the orifices being composed of a sintered mixture of tungsten carbide powder and from one percent to twenty percent of a platinum group metal powder, at least a portion of the length of each orifice having cylindrical walls terminating in the outlet face.

2. A spinnerette comprising a plate portion, a plurality of extrusion orifices passing through the thickness of the plate, the material defining the orifices being composed of a sintered mixture of tungsten carbide powder and from one percent to twenty percent of a platinum group metal powder, at least a portion of the length of each orifice having cylindrical walls of from about 0.003 inch to about 0.0625 inch diameter, the cylindrical walls having a length of from about 0.005 inch to about 1.0 inch.

3. A spinnerette comprising a plate portion, a plurality of extrusion orifices passing through the thickness of the plate, the material defining the orifices being composed of a sintered mixture of tungsten carbide powder and from one percent to twenty percent of a platinum group metal powder, at least a portion of the length of each orifice having cylindrical walls of from about 0.003 inch to about 0.0625 inch diameter, the cylindrical walls having a length of from about 0.005 inch to about 1.0 inch, the plate having a thickness of from 0.125 inch to about 1.0 inch.

4. A spinnerette according to claim 3, wherein the plate is a metal plate having a plurality of apertures formed therethrough, an insert member nested in each aperture, one of said apertures formed through said insert member.

5. A spinnerette comprising a plate portion, a plurality of extrusion orifices passing through the thickness of the plate, the material defining the orifices being composed of a sintered mixture of tungsten carbide powder and from one percent to twenty percent of a platinum group metal powder, at least a portion of the length of each orifice having cylindrical walls of from about 0.003 inch to about 0.0625 inch diameter, the cylindrical walls having a length of from about 0.005 inch to about 1.0 inch, the plate having a thickness of from 0.125 inch to about 1.0 inch, said plate having an inlet face and an extrusion face, the cylindrical walls terminating in partly defined edges in the plane of the outlet face.

6. A spinnerette comprising a plate portion, a plurality of extrusion orifices passing through the thickness of the plate, the material defining the orifices being composed of a sintered mixture of tungsten carbide powder and from one percent to twenty percent of a platinum group metal powder, at least a portion of the length of each orifice having cylindrical walls of from about 0.003 inch to about 0.0625 inch diameter, the cylindrical walls having a length of from about 0.005 inch to about 1.0 inch, the plate hav-

5

ing a thickness of from 0.125 inch to about 1.0 inch, said plate having an inlet face and an extrusion face, the cylindrical walls terminating in sharply defined edges in the plane of the outlet face, the orifices each having an inlet portion partly through the thickness of the plate and merging with said cylindrical walls.

7. A spinnerette according to claim 5, wherein the material consists of tungsten carbide powder and fifteen percent platinum powder.

8. A spinnerette according to claim 5, wherein the material consists of tungsten carbide powder and five percent platinum powder.

5

10

6

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