

April 6, 1954

R. K. LADISCH
POLYMERIC FILAMENTS
Filed Aug. 15, 1949

2,674,025

Fig. 1.

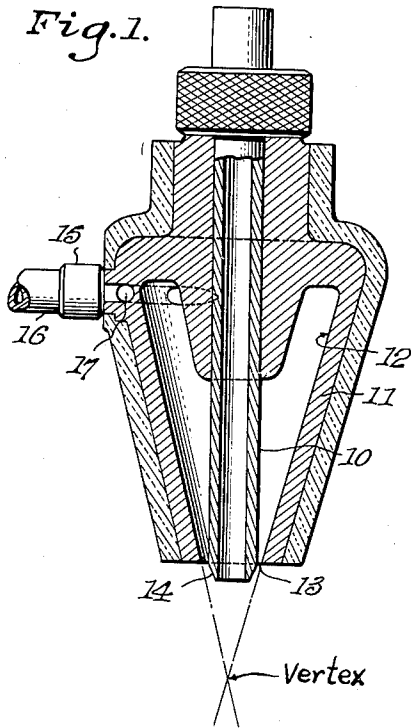


Fig. 2.

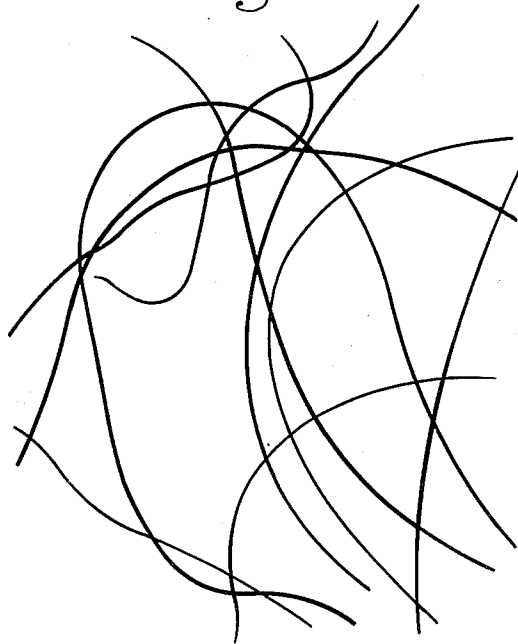


Fig. 3.

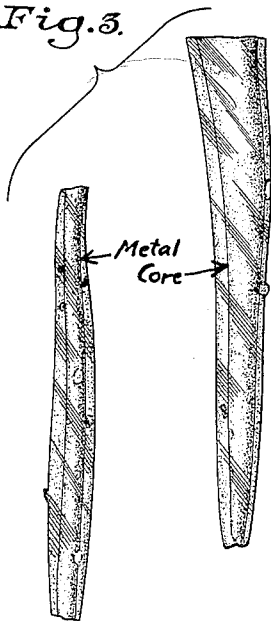
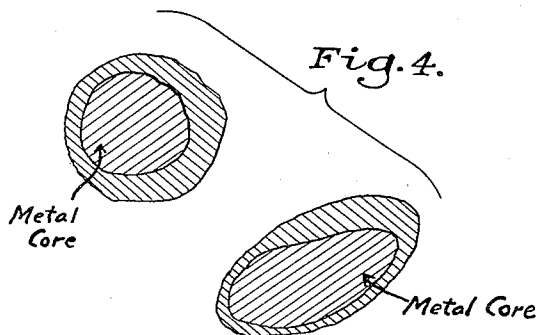


Fig. 4.



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2,674,025

POLYMERIC FILAMENTS

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Application August 15, 1949, Serial No. 110,372

5 Claims. (Cl. 28—82)

(Granted under Title 35, U. S. Code (1952),
sec. 266)

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The invention described herein, if patented, may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to polymeric filaments having fillers incorporated therein and methods of making the same, and is an improvement on the invention disclosed in my abandoned application, entitled "Melt-Sprayed Polymer Wool and Method of Making the Same," Ser. No. 89,776 filed April 26, 1949. Filaments of this invention may be matted together to form light-weight polymeric wools having improved characteristics or after twisting to make a yarn may be woven or knitted to make textile-like articles for many different uses.

In accordance with the present invention, filaments are formed by melt-spraying with the aid of a particular type of nozzle, to form filaments consisting essentially of polymeric tubular envelopes whose walls enclose cores which may be metallic or non-metallic, but which always constitute an important part of the mass of the filament, and may constitute a major part thereof. These cores may be of substantially uniform diameter throughout the length of the filament or may be of varying diameter, but in all observed cases the walls of the filaments are free from the bulges or swellings which are disclosed in my Patent No. 2,571,457 dated October 16, 1951, and claimed in a divisional application now Patent No. 2,612,679 dated October 7, 1952.

I am aware it is old as proposed in the Gardner Patent No. 1,692,372, dated November 20, 1928, to mix a salt or oxide of titanium with "artificial silk" prior to spinning to delusterize the filaments. Other patents suggesting the addition of various salts and pigments to filaments are the Taylor Patent No. 2,034,008; the Helm et al. Patent No. 2,233,344; and the Spanagel Patent No. 2,385,890.

Filaments made pursuant to the invention may be of increased resilience and flexibility. The electrostatic, electro-conductive, magnetic and insulating qualities and the weight, "feel," curliness and other physical characteristics of filaments may be materially changed by following the invention, to effect considerable improvements over filaments made from the pure polymer with or without a plasticizer.

In the accompanying drawings forming a part of this specification—

Fig. 1 is a cross section through the preferred form of nozzle used in forming the filaments;

Fig. 2 is a photomicrograph of a number of

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polyvinyl acetate filaments combined with selenium;

Fig. 3 is a similar view of two cellulose propionate and tin fibers; and

Fig. 4 is a similar view showing in greatly enlarged cross section two cellulose propionate filaments with solid cores of metallic tin.

Referring to Fig. 1, the nozzle there shown is similar to the nozzle of German Patent No. 411,948 and corresponding U. S. Patent No. 1,811,637 issued to Carl Ladisch on June 23, 1931. It comprises a straight, central tube 10 through which the hereinafter defined "polymeric mixture" flows, and a frusto-conical body 11 with conical internal walls 12 and an open end 13. The end of tube 10 projects slightly beyond the end of the frusto-conical body 11 and is beveled as indicated at 14, the arrangement being such that the projecting beveled end of tube 10 does not in any way interfere with or deflect the flow of gas or vapor from the open end 13 of the conical body. A coupling 15 connects a gas discharge pipe 16 to the nozzle; usually the gas led to the nozzle will be air (or where a non-oxidizing gas must be used, nitrogen, helium, producer gas, steam, etc. may be employed), and such gas will be heated if the polymer is being melt-sprayed. The gas enters the nozzle at its larger end through a port 17, flowing under superatmospheric pressure in a tangential path and then in a spiral path with constantly increasing velocity due to the decreasing diameter of the nozzle, until finally it emerges as a spiral or whirling jet through the narrow annular space between the tube 10 and the open end 13 of the nozzle. Beyond the discharge opening the gas or vapor continues to flow in a contracting spiral path at constantly increasing velocity until it reaches a point (marked "Vertex") which is the apex of the cone of the internal walls 12 of the nozzle. At this point theoretically the velocity becomes infinite, but actually, due to air friction and other causes, is a finite figure of supersonic velocity, that is, higher than the velocity of sound in air at sea level. The formation of the filaments takes place at and near this "Vertex."

The term "polymeric mixture," as used above and elsewhere in this specification, denotes a single polymer or copolymer with or without a plasticizer or a plurality of physically mixed polymers and copolymers. Obviously the "polymeric mixture" must be such that it will not decompose under the conditions of heat and pressure necessary to form the filaments. Among the polymers and copolymers which may

be used are: polystyrene, polydichlorostyrene, polyamides of the nylon type, polyacrylonitrile, polymethacrylonitrile, polymethyl methacrylate, polymethyl acrylate, polyvinylidene chloride, polyvinyl chloride, polyvinyl carbazole, polyvinyl alcohol, polymeric glycol terephthalate, cellulose acetate, cellulose propionate, cellulose acetate butyrate, cellulose nitrate, ethyl cellulose, polyethylene, halogenated polyethylenes, polybutene, polyisobutylene, polyvinyl butyral, polyvinyl acetate and silicones. The term "gas" as used herein includes gaseous mixtures such as air, also vapors such as steam.

To mixtures or mixed melts of the selected "polymeric mixture," powdered metal or other powdered solids are added prior to the feeding of said mixture to the nozzle. In lieu of powdered metals, molten metals of low melting point such as tin, metalloids, such as selenium, and low melting alloys such as soft solder, Rose's metal, Newton's metal and Wood's metal may be added to the molten polymeric mixture. Due primarily to the described nozzle construction, relatively large amounts, as much as 80%, may be added without running the risk of clogging the nozzle. In other words, the described nozzle makes possible for the first time the forming of filaments heavily laden with a metallic or metalloidal content, so that the filaments are more pronouncedly metallic (or metalloidal) than polymeric.

When selenium (80% by weight) was added to polyvinyl acetate (Mowilith 30), it was in finely divided form, passing through a 250 mesh sieve. The nozzle temperature was 240° C., and the air pressure was 20 p. s. i. The filaments formed (Fig. 2) had a volume per weight ratio of 23 and a diameter ranging from 1 to 18 microns. Fig. 2 (magnification 90X) is only an approximation of a few of the fibers forming a curly, tangled mass. The selenium was such a large part of the fibers that it imparted a dark brown appearance and gave a rather harsh feel to them, besides making them quite brittle. Each fiber however consisted of a continuous thin tubular envelope surrounding the metalloidal core. The mixing of polyvinyl acetate with molten selenium in a 50--50 by volume ratio results in a homogeneous viscous mixture at 240° C. which readily forms filaments, again with the metalloid forming a core sheathed by the resin.

Fig. 3 shows the ends of two cellulose propionate fibers containing tin cores, enlarged 35 times. Cellulose propionate (Forticel 28102) was mixed with tin powder passing a 325 mesh sieve, and the mixture was sprayed with a nozzle pressure of 15 p. s. i. and 3 p. s. i. pressure in the inner tube 10. Temperatures were 250° C. in the inner tube and 270° C. for the compressed air. While part of the mixture left the "Vertex" in the form of plain polymeric fibers and separate tin pellets,

a considerable percentage of plastic fibers with tin cores were formed. These tin cores were not continuous but varied in diameter (as Fig. 3 shows) as well as in length, some being as short as 2 mm., others being measured as 50 mm. long. Fig. 4 (magnification 625X) shows in section solid tin cores which are a major part of the fibers, but in some sections the tin cores were so small that they could only be seen under the microscope, after dissolving away the polymeric envelope with methyl acetate. Microscopic examination failed to disclose a single tin fiber free from a surrounding polymer.

Reference should be made to Patent No. 2,571,457 for a disclosure of apparatus suitable for practicing the method of the invention.

What I claim is:

1. Artificial filaments each consisting of a resinous polymeric mixture forming a generally tubular envelope with unbroken walls and non-uniform thickness, and at least one core within said envelope forming a major fraction of the mass of the filament and being of a material selected from the group consisting of all metals, metalloids and alloys which are molten at the temperature of formation of the filaments and which form at least one solid core in the filaments, said core being of irregular but substantially circular cross section which varies non-uniformly in diameter along its length and which also varies in its position within the envelope.

2. The invention according to claim 1 wherein the core is of selenium.

3. The invention according to claim 1 wherein the core is of selenium which forms not more than about 80% by weight or about 50% by volume of the filament.

4. The invention according to claim 1 wherein the core is composed of metallic tin.

5. The invention according to claim 4 wherein the tin is in discontinuous cores distributed along the length of the filament.

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