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H. J. JONES

2,362,277

SPINNERETTE

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Fig. 1

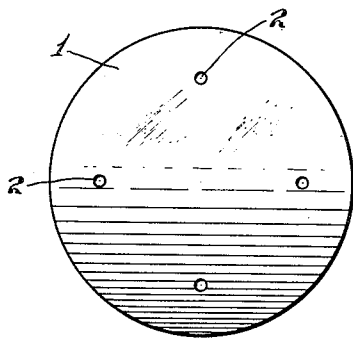


Fig. 3

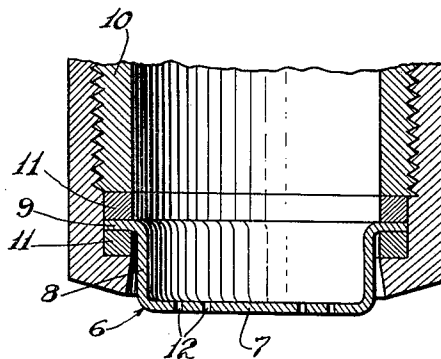
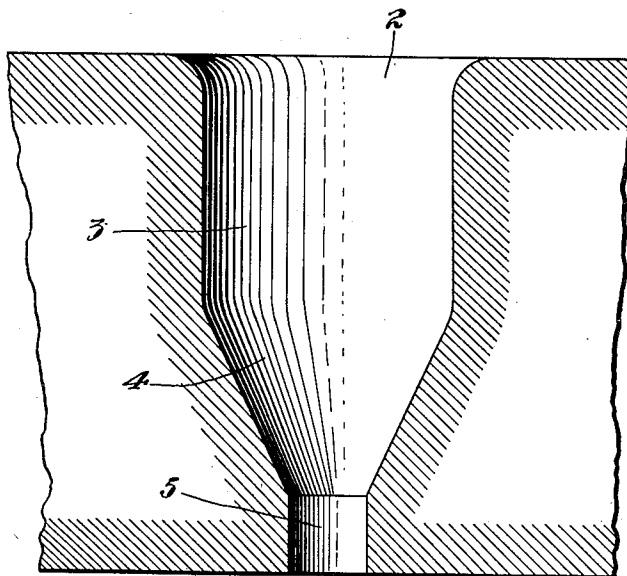


Fig. 2



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UNITED STATES PATENT OFFICE

2,362,277

SPINNERETTE

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3 Claims. (Cl. 18—8)

This invention relates in general to spinnerettes for the extrusion of organic viscous substances in the spinning of artificial filaments and is concerned in particular with the provision of spinnerettes for the spinning of synthetic substances such as synthetic polyamides and other polymerization products of fiber forming ability such, for instance, as those described more particularly in U. S. Letters Patents No. 2,071,250, No. 2,071,251, No. 2,071,252, No. 2,071,253, No. 2,130,947, and No. 2,130,948.

This application is a continuation-in-part of my earlier application Serial No. 249,360, filed January 5, 1939, and my application Serial No. 422,648, filed December 12, 1941.

Spinnerettes for the extrusion of organic substances in the spinning of rayon or other artificial filaments, fibers, or yarns, usually comprise a spinning plate in the form of a disc or cup provided with a plurality of minute orifices, usually from 0.001" to 0.032" in diameter, through which the viscous mass, the viscosity of which often approaches the dry state, is extruded to form the filaments and the like. Spinnerettes are constructed of precious metal in the spinning of filaments and the like in the viscose process, and of base metal in the spinning of filaments and the like in the acetate and cuprammonium processes.

It is one object of this invention to provide a base metal spinnerette which shall be superior to base metal spinnerettes heretofore known. It is another object of this invention to provide a base metal spinnerette which shall be suitable for the spinning of artificial filaments and the like from polymerization products of fiber forming ability. It is a further object of the invention to provide such spinnerettes which shall be capable of spinning such artificial filaments and the like under pressure and at elevated temperatures, such as several hundred pounds pressure per square inch and at a temperature of at least 200° C. Other objects and advantages of the invention will appear from the description thereof hereinafter following.

In the spinning of artificial filaments in the acetate and cuprammonium processes base metals such as nickel, nickel alloys, tantalum, and stainless steels containing nickel, have been found suitable. Such spinnerettes are, however, not always satisfactory under severe operating conditions and are in particular not especially suitable in the spinning of artificial filaments and the like from synthetic polyamides and other polymerization products of fiber forming ability,

such as described in the aforesaid U. S. Letters Patents No. 2,071,250, No. 2,071,251, No. 2,071,252, No. 2,071,253, No. 2,130,947, and No. 2,130,948, where spinning takes place under pressure and at elevated temperature and under otherwise exacting operating conditions resulting from the nature of the extrusion mass.

I have discovered that the objects of my invention can be achieved and that a superior base metal spinnerette for the purposes described can be produced by constructing such spinnerette of a chromium steel containing not less than 14% but not more than 20% chromium, preferably from approximately 17% to approximately 19% chromium, provided such steel is substantially free from nickel. Such steel should contain not more than 0.5% carbon, but may contain slight impurities sometimes encountered in chromium steels such as manganese, phosphorus, molybdenum, sulphur, silicon, and copper.

The spinnerette of the invention is illustrated in the accompanying drawing in which:

Fig. 1 is a top plan view of one type of spinnerette,

Fig. 2 is a fragmentary enlarged vertical sectional view through the spinnerette wall, and

Fig. 3 is a transverse vertical sectional view on an enlarged scale through an extrusion apparatus including another type of spinnerette.

Fig. 1 shows the spinnerette in the form of an extrusion plate or disc 1, constructed of stainless steel substantially free from nickel and consisting essentially of iron and chromium containing from 14% to 20% chromium, and provided with extrusion orifices or holes 2. As shown in Fig. 2 the extrusion orifices 2 may comprise a cylindrical counterbore 3, an intermediate portion 4, and an outlet portion 5, the walls of the three portions forming a smooth and uninterrupted flow surface. Fig. 3 shows a cup shaped type of spinnerette having a cup shaped body 6, likewise constructed of the same stainless steel as in the case of disc 1 of Fig. 1, the said cup shaped body 6 comprising a bottom wall 7 and cylindrical walls 8, the bottom wall being provided with a plurality of extrusion orifices or holes 12. The spinnerettes may be attached to the extrusion apparatus in known manner, the spinnerette 6 of Fig. 3 for instance being clamped by means of a flange 9 on the end of an extrusion tube or pipe 10 between gaskets 11.

In particular I have found especially suitable, and I therefore recommend in particular, a spinnerette of chromium steel containing approxi-

mately 18% chromium and 0.10% carbon, rest iron, and free from nickel.

Such spinnerettes according to the invention are extremely hard and will withstand the highest pressures normally encountered in the production of artificial filaments and the like from synthetic polyamides and other fiber forming polymerization products. At the same time such spinnerettes are capable of being operated at the elevated temperatures usual in the spinning of such synthetic substances and are not attacked chemically by the extrusion mass. While permitting the formation of minute orifices therein the metal of the spinnerette is sufficiently strong to withstand abrasion and wear, in the presence of the flowing extrusion mass, so that the constancy of the dimensions of the minute extrusion orifices is maintained. The walls of the orifices in such spinnerette are capable of taking, and retaining throughout the operation, a beautiful high polish, and as the walls of such orifices do not become roughened in use, whether by chemical or mechanical action, and as the orifices are not deformed under pressure, assuming a proper thickness of extrusion plate in proportion to the pressure exerted thereupon, the extrusion mass flows quickly and freely through the orifices of the spinnerette, particularly as the nature of the spinnerette is such that clogging of orifices is kept at a minimum, with the result that the spinning process can operate at relatively high speed to produce filaments and the like of uniform cross-section and high quality. Another feature of the spinnerette in accordance with the invention is that it can be cleaned with boiling nitric acid, or other suitable cleaning acids, without interference with the smooth surface of the extrusion orifices. Enlargement of the orifices, which likewise would result in the production of filaments of irregular or poor quality, is fully prevented in the spinnerette of the invention, and damage by rough handling or other abuse by the operator is kept at a minimum.

The spinnerette of the invention is designed especially for the spinning of synthetic polyamides and other polymerization products of fiber forming ability, as aforesaid, where base metal spinnerettes, as heretofore known, including such stainless steel spinnerettes as heretofore known, are not sufficiently suitable. Such polymerization products can be extruded, through my spinnerettes, by the wet process, the dry process, or the melt process. I have also found that the spinnerettes according to the invention are superior to such base metal spinnerettes as heretofore known, even in the spinning of artificial filaments and the like from other synthetic substances, as in the acetate and cuprammonium processes, where, as distinguished from the spinning of fiber forming polymerization products, spinnerettes of other base metals, such as stainless steels containing substantial quantities of nickel, for instance from 7% to 10% nickel, are suitable as such.

In providing spinnerettes in accordance with the invention it is of critical importance, in order to produce a spinnerette having the superior qualities described, that the chromium steel, containing from 14% to 20% chromium, be substantially free from nickel. I have found that the best spinnerettes are produced from such steels which are free from nickel, although it will be understood that a minor quantity of nickel will not sub-

stantially interfere with the performance of my spinnerettes as the effect of nickel progressively decreases with decreasing amounts; in which connection I have found, however, that a proportion of 2% nickel is already in excess of that quantity of nickel which I consider permissible in the construction material of the spinnerettes according to the invention. The term "substantially free from nickel" as herein used is meant, therefore, to indicate that the construction material of the spinnerette contains definitely less than 2% nickel and is preferably entirely free from nickel. The presence of nickel tends to decrease the general resistance of the spinnerette to adverse mechanical and chemical factors and affects, for instance, the ability of the spinnerette to withstand cleaning with boiling nitric acid. The marked superiority of the spinnerette of the invention over other spinnerettes of base metal, ceases when the chromium content falls below 14% or exceeds 20%, or when the chromium steel contains 2% or more of nickel.

The spinnerettes of the invention as employed in practice in the spinning of artificial filaments and the like from fiber forming polymerization products, designed for high pressure operations at elevated temperatures, are formed in the shape of a disc having a thickness of about 0.2" and provided with orifices, illustrated particularly in Fig. 2, consisting of a relatively narrow cylindrical outlet portion 5, the inlet portion 3 comprising a cylindrical counterbore having a diameter substantially larger than that of the outlet portion, and an intermediate portion 4 having a tapered wall directly connecting the end of the inlet portion with the beginning of the outlet portion, the walls of the three portions forming a smooth and uninterrupted flow surface. The shape of such orifice is more particularly described in my co-pending application Serial No. 422,648, filed December 12, 1941, now Patent #2,341,555.

In general, the thickness of the spinning plate ranges from 0.06" to 0.4", and the extrusion orifices have a cross-section, at the extrusion end, of the order of 0.001" to 0.032".

What I claim is:

1. A spinnerette for the spinning of artificial filaments and the like from synthetic polymerization products of fiber forming ability, constructed of stainless steel substantially free from nickel and consisting essentially of iron and chromium wherein the chromium content does not fall below 14% and does not exceed 20%.

2. A spinnerette for the spinning of artificial filaments and the like from synthetic polymerization products of fiber forming ability, constructed of stainless steel substantially free from nickel and consisting essentially of iron and chromium wherein the chromium content does not fall below 17% and does not exceed 19% and wherein the carbon content does not exceed 0.5%.

3. A spinnerette for the spinning of artificial filaments and the like from synthetic polymerization products of fiber forming ability, constructed of stainless steel substantially free from nickel and consisting essentially of iron and chromium wherein the chromium content comprises about 18% and the carbon content comprises about 0.10%.

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