Sept. 26, 1961 I. ROSSI 3,001,230

SPINNERETTE NOZZLES

Filed Jan. 29, 1959 2 Sheets-Sheet 1

Fig. 1

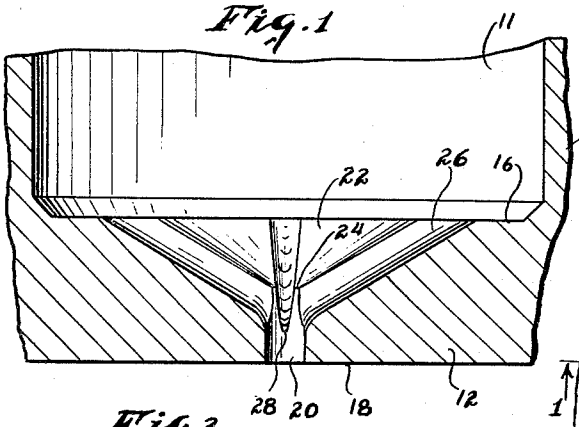


Fig. 2

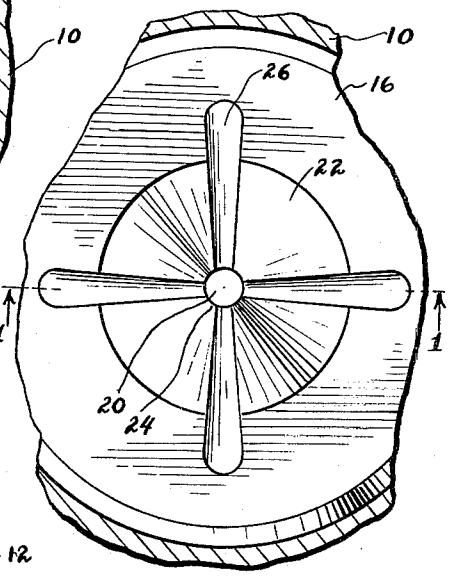


Fig. 3

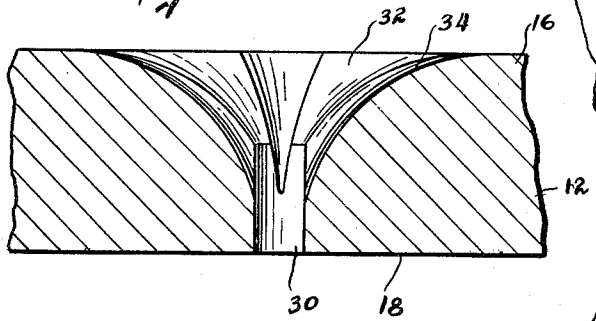


Fig. 5

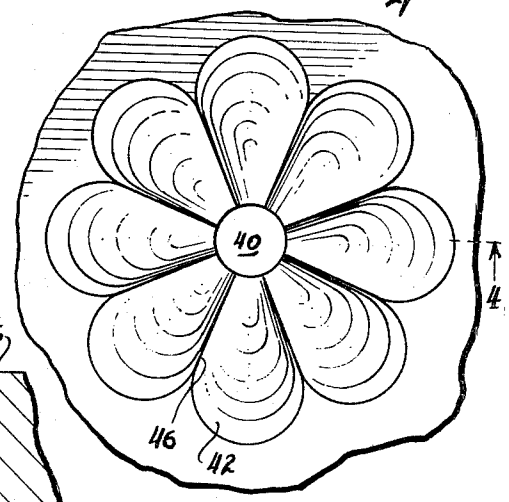
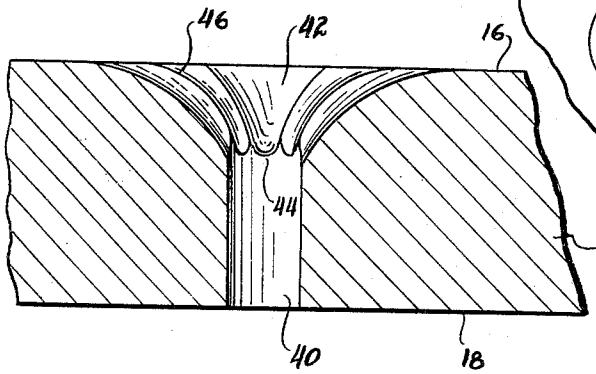


Fig. 4



INVENTOR.
IRVING ROSSI

BY

Emery, Whittemore, Sandoz & Dix

ATTORNEYS

Sept. 26, 1961 I. ROSSI 3,001,230

SPINNERETTE NOZZLES

Filed Jan. 29, 1959 2 Sheets-Sheet 2

Fig. 6

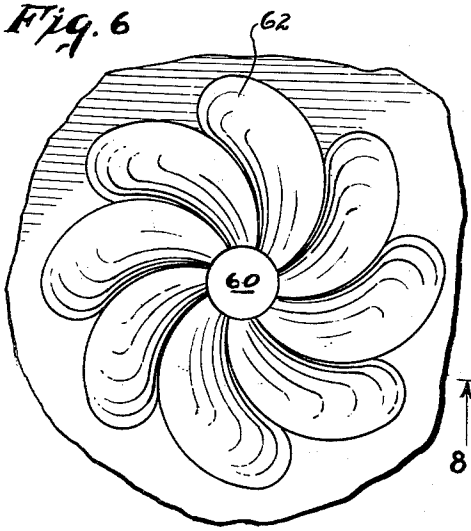


Fig. 7

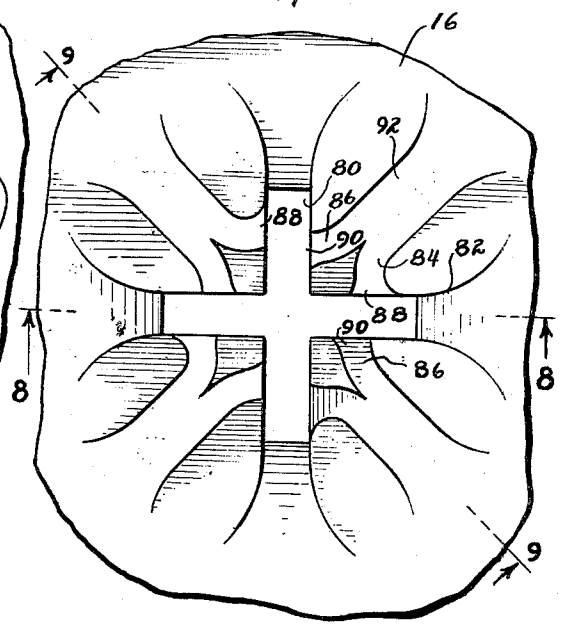


Fig. 8

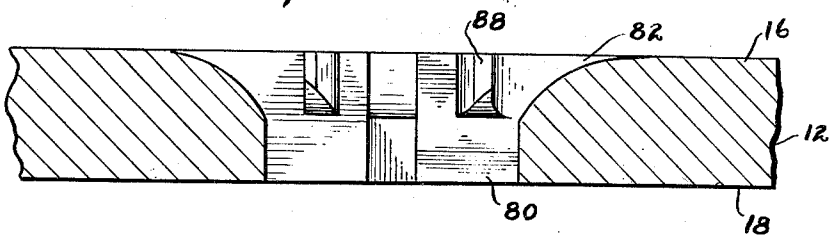
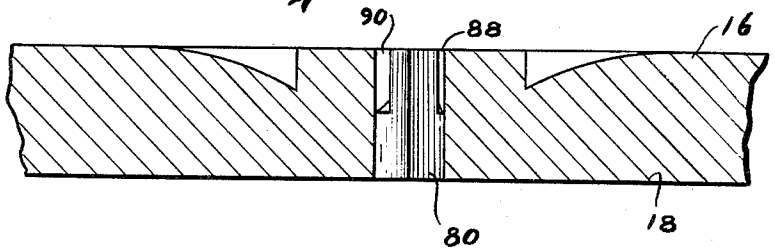


Fig. 9



INVENTOR.
IRVING ROSSI

BY

Emery, Whittemore, Sandberg & Dy

ATTORNEYS

United States Patent Office 3,001,230 Patented Sept. 26, 1961

3,001,230

SPINNERETTE NOZZLES

Irving Rossi, Morristown, N.J., assignor to Eltherma A.G., Vaduz, Liechtenstein, a corporation of Liechtenstein

Filed Jan. 29, 1959, Ser. No. 789,821
10 Claims. (Cl. 18—8)

This invention relates to spinnerettes and, more particularly, arrangements for improved material feed to the spinnerette orifice.

Spinnerettes are used for the extrusion of plastics into filaments. When the plastic is forced through the spinnerette nozzle, the speed of the plastic material changes from a relatively slow flow to a relatively high-speed flow. In the change of rate of flow, despite the normally high viscosity of the plastic material, turbulent disturbances of the flow in the spinnerette nozzle are caused which turbulence interferes with the spinning operation.

With a discharge orifice of circular cross-section, a gradual change of nozzle diameter from the intake to the spinning orifice has been used to improve material flow. An example of such construction is shown in U.S. Patent No. 2,341,555.

However, gradual decrease to the discharge orifice does not completely solve the problems involved at higher flow rates, since it fails to destroy the circular and longitudinal turbulence involved. Further, at the higher extrusion speeds, the greater velocity of the material along the conical sides tends to pinch off the very fine filament being extruded.

Further, it has been found desirable to employ spinnerettes having shaped discharge orifices (such as stars and crosses) instead of a circular cross-section. With such shaped discharge orifices the problem of material flow during extrusion becomes increasingly acute. For example, in a cross shape spin hole, difficulty with filling the ends of the cross members has been experienced.

It is, therefore, one object of my invention to provide an improved spinnerette nozzle for the extrusion of viscous material without the creation of interfering turbulent disturbances.

It is a further object of my invention to provide an improved spinnerette nozzle for extruding filaments having geometrically shaped cross-sections.

Other objects and advantages will be described in the specification, pointed out in the claims, and illustrated in the accompanying drawings of which:

FIGURE 1 is an axial cross-sectional view of a nozzle in a counterbored spinnerette.

FIGURE 2 is a top plan view of the nozzle shown in FIGURE 1.

FIGURE 3 is an axial cross-section of another embodiment of the spinnerette nozzle embodying this invention.

FIGURE 4 is an axial cross-section of another embodiment of this invention.

FIGURE 5 is a top plan view of the nozzle shown in FIGURE 4.

FIGURE 6 is a top plan view of another embodiment of this invention.

FIGURE 7 is a plan view of another embodiment of this invention for use with a spinnerette nozzle having a cross shaped orifice.

FIGURE 8 is an axial cross-section taken through lines 8—8 of FIGURE 8, and

FIGURE 9 is an axial cross-section taken through lines 9—9 of FIGURE 8.

In FIGURE 1, there is shown a spinnerette **10** in which there is a counterbore **11**. The plate **12** at the bottom of the counterbore is sufficiently strong to withstand the material pressure required to extrude the plastic material

through the nozzle **14** which extends through the plate **12** from the pressure side **16** to the discharge side **18** thereof.

The spinnerette **10** is dimensioned to withstand the extruding pressures. Since it would be difficult to drill the tiny spinnerette nozzle through this heavy plate, smaller areas are counterbored to leave a thinner nozzle plate which is sufficiently strong to withstand the smaller total force imposed by the extruding pressure. At lower pressures or with less viscous materials, the entire spinnerette plate may be thin and the nozzle drilled therethrough. Since this invention is directed at the nozzle arrangements, the following description and illustration will be directed thereto, it being understood that the nozzle may extend through the bottom plate of a counterbore in a spinnerette or through the spinnerette itself.

The nozzle comprises a cylindrical discharge orifice **20** extending from the discharge surface of the plate. An annular wall **22**, integral with the discharge orifice wall, extends upwardly therefrom to the pressure surface **16** of the plate. The annular wall is flared outwardly in a cone to provide means for graduating the velocity of extruded material as it passes from the extruder to the discharge opening. As described thus far, the construction is similar to that shown in U.S. Patent No. 2,341,555.

In order to alleviate any rotational turbulence in the flow and to alleviate longitudinal turbulence occurring near the edge **24** between the wall of the discharge orifice and the conical wall **22**, a plurality of guide channels **26** are provided. The guide channels are formed in the conical wall to provide means for feeding material into the discharge orifice below edge **24**. It has been found preferable to form the channels with an outward taper and to round the channel into a curve **28** as it enters the discharge orifice.

The channels extend radially from the discharge orifice as is best understood by reference to FIGURE 2.

Because of the small dimensions of such nozzles, it has been found that the nozzle is best formed by electron beam machining; that is, by directing a controlled beam from an electron gun to machine the material into the desired shapes. The plate material must be sufficiently strong to resist distortion by the extrusion pressure. For this purpose, for example, stainless steel is satisfactory.

In FIGURE 3 there is shown a plate **12** having a pressure face **16** and discharge face **18**.

A spinnerette nozzle extends through the plate and has a cylindrical discharge orifice **30**. Extending from the top of the discharge orifice to the pressure face is an annular wall **32** integral with the wall of the discharge orifice. The wall flares outwardly in hyperbolic curve. Guide channels **34** are machined in the annular wall **32** to extend outwardly in a hyperbolic curve. The guide channels extend radially outwardly as with the embodiment shown in FIGURE 2. The channels operate as explained in connection with the embodiment shown in FIGURES 1 and 2. However, the transition from channel to orifice is a smoother curve.

It is often found desirable to provide a plurality of guide channels for flow control. An example of such an embodiment is shown in FIGURE 4. There is shown the plate **12** with a nozzle extending therethrough from the pressure face **16** to the discharge face **18**. The nozzle comprises a cylindrical discharge orifice **40**. Extending from the top of the discharge orifice to the pressure face are a plurality of guide channels **42**. The guide channels are cut into the plate material flaring outwardly from the annular surface of the discharge orifice and widening to be contiguous one to the other as is best shown in FIGURE 5. Thus the guide channels terminate in semi-circular discharge openings **44** in the discharge

orifice and are separated from each other by ridges 46 to give proper guidance to the extruded material.

In the nozzle shown and described in the above specification the guide channels are formed extending radially from a circular discharge orifice. In spinning material composed of long molecular chains, such as the various polymerized plastics, the nozzle shown in FIGURE 6 may advantageously be employed.

In FIGURE 6 there is shown a discharge orifice 60 from the top of which guide channels 62 extend to the pressure face of the plate. The guide channels extend outwardly in a spiral form so that material enters the discharge orifice tangentially. This has been found to give improved flow control under some circumstances.

In those applications where it is desired that the spun filament have a cross-sectional shape other than that of a circle, the arrangement shown in FIGURES 7, 8 and 9 may advantageously be employed.

In the figures, there is shown a discharge orifice 80 in the shape of a cross. Extending from the ends of the cross are guide channels 82 extending upwardly to the pressure face 16. Guide channels 84 and 86 extend from the cross arms to the pressure face 16 of plate 12. The guide channels 84, 86 enter the cross arms at different positions 88 and 90 respectively on each side of the cross arms but for convenience of construction are joined into a single feed channel 92 near the pressure face. By this arrangement means for feeding the discharge orifice at various points to insure uniformity of flow rate and continuous filling of the discharge orifice is provided. By such means, the tendency of the plastic material leaving the discharge orifice to form itself into a cylindrical filament is eliminated. With discharge orifices of such shapes it has been found that the different parts of the orifice will offer different resistance to the flow of extrusion material, thus creating turbulence. The guide channels, supplying material to high resistance portions, eliminate turbulence and insure that the rate of material flow during extrusion is held constant for all parts of the discharge orifice.

It will be recognized by those skilled in the art that the spinning of some materials will require slight alterations and modifications in the guide channels to fit the spinning conditions.

It will further be recognized that various modification and embodiment can be made within the scope of the subjoined claims.

What is claimed is:

1. A spinnerette nozzle extending through a plate from the pressure face to the discharge face thereof, comprising a discharge orifice extending inwardly from the discharge face to a plane between the discharge and pressure faces of the plate, a wall portion integral with the discharge orifice at said plane and flaring outwardly therefrom to the pressure face of said plate, and a plurality of guide channels formed in said outwardly flared wall portion, said channels extending from said pressure face and terminating in said discharge orifice below said plane.

2. A spinnerette nozzle in accordance with claim 1 in which said guide channels extend radially outwardly.

3. A spinnerette nozzle in accordance with claim 1 in which said channels are flared outwardly from said discharge orifice in a hyperbolic curve.

4. A spinnerette nozzle according to claim 1 in which said guide channels extend outwardly in a spiral.

5. A spinnerette nozzle according to claim 1 in which said discharge orifice is in the form of a cross and said guide channels extend between the ends of the arms of the cross and the pressure face of said plate.

6. A spinnerette nozzle according to claim 1 in which said discharge orifice is the shape of a cross and in which said guide channels extend from the midpoints of the arms of the cross to said pressure face.

7. A spinnerette nozzle according to claim 1 in which said discharge orifice is of circular cross section and in which said wall portion is a surface of revolution.

8. A spinnerette nozzle according to claim 1 in which said channels are contiguous.

9. A spinnerette nozzle in accordance with claim 1 in which said orifice has a cross-sectional shape which is not radially symmetrical, and said channels extend in fluid transfer relationship from the wall of said orifice at positions of high flow resistance to the pressure face of said plate.

10. A spinnerette nozzle according to claim 1 in which the discharge orifice offers different resistance to fluid flow therethrough at different parts thereof and said guide channels are positioned to maintain a constant rate of flow through said discharge orifice.

References Cited in the file of this patent

UNITED STATES PATENTS

2,149,425	Draemann	Mar. 7, 1939
2,734,224	Winstead	Feb. 14, 1956
2,742,667	Clouzeau et al.	Apr. 24, 1956
2,817,115	Freifeld et al.	Dec. 24, 1957

FOREIGN PATENTS

706,111	Great Britain	Mar. 24, 1954