Sept. 3, 1963 W. MARTIN ET AL 3,102,439

MANUFACTURE OF SPINNERETTES WITH ORIFICE INSERTS

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FIG. 1

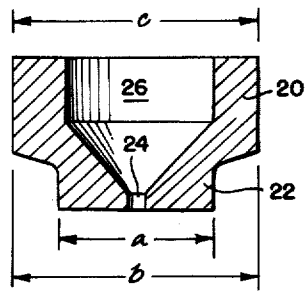


FIG. 2

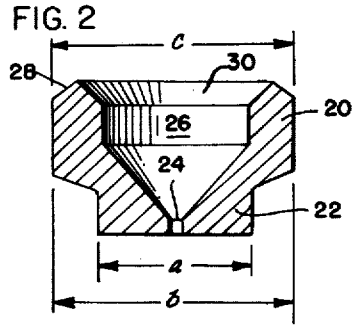


FIG. 3

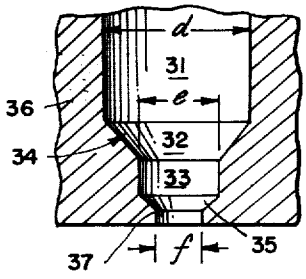


FIG. 4

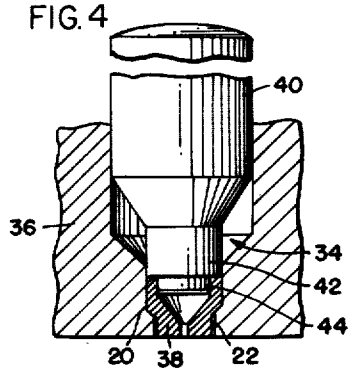


FIG. 5

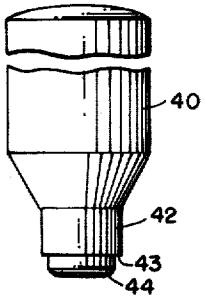


FIG. 6

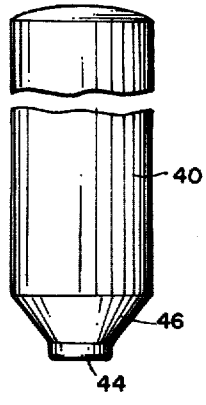
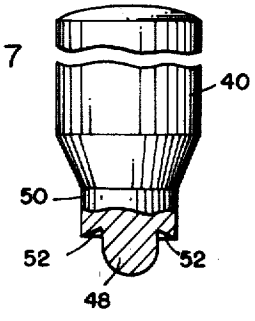


FIG. 7



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FIG. 8

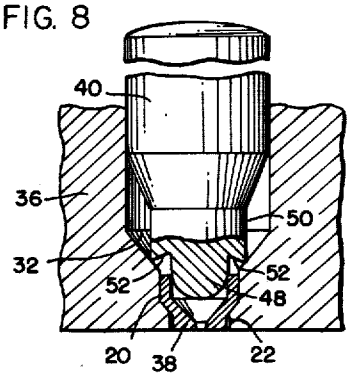


FIG. 9

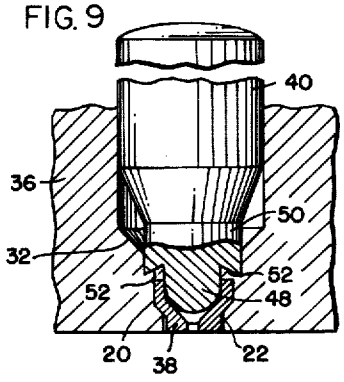


FIG. 10

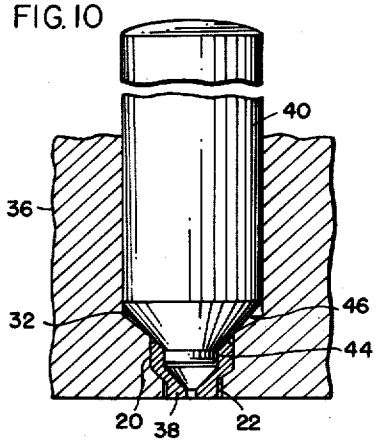


FIG. 11

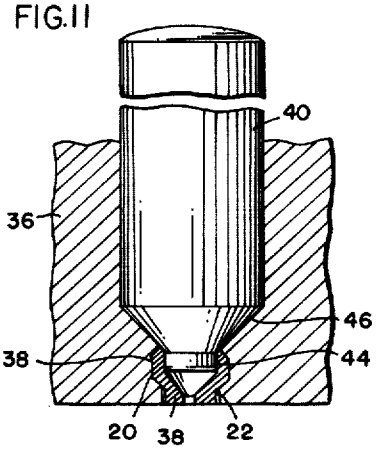
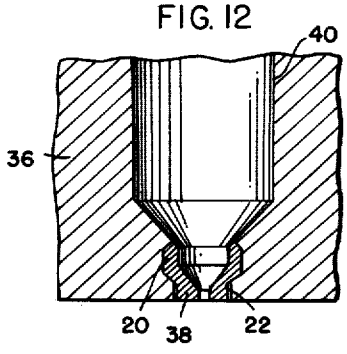


FIG. 12



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MANUFACTURE OF SPINNERETTES WITH ORIFICE INSERTS

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Original application Feb. 28, 1958, Ser. No. 718,202, now Patent No. 3,006,026, dated Oct. 31, 1961. Divided and this application May 18, 1961, Ser. No. 111,897
Claims priority, application Germany Mar. 2, 1957
10 Claims. (Cl. 76—107)

This invention in general relates to the manufacture of spinnerettes with orifice inserts. More particularly, the invention relates to processes of manufacture of spinnerettes in which inserts having predrilled spinning orifices are securely mounted in predrilled apertures in the spinning faces of spinning nozzles. The invention is also concerned with a tool used in the manufacture of said spinnerettes.

This is a divisional application of our copending application Serial No. 718,202, filed February 28, 1958, which issued as Patent No. 3,006,026, on October 31, 1961.

It is a known practice to produce spinnerettes for the production of synthetic threads by pressing inserts into predrilled, apertured spinning faces. These inserts may be provided with spinning orifices prior to their mounting in said faces as long as the inserts can be set in from the outer side of the face. This type of mounting is satisfactory for certain spinning processes. For example, these spinnerettes are satisfactory for use in the viscose industry, because relatively low spinning pressures are employed. If, however, higher pressures prevail in the spinning head, viz., in the fluid spinning of synthetic filament-forming polymers, then the inserts have to be forced in from the inside. In these cases, it has heretofore been impossible to bore the spinning openings in the inserts in advance of their mounting in the spinnerette because spinning openings are easily deformed while the inserts are being forced into place.

In accordance with our invention, it was found that it is possible to press into position inserts having predrilled spinning apertures or passages polished to high brilliancy into the predrilled, apertured spinnerette face from the inside of the spinnerette without deforming the spinning passages, if the inserts, the drilling of the apertures in spinnerette face and the press die with which the insert is pressed into the spinnerette apertures have shapes and size interrelationships which will be described in detail in the following.

It is an object of this invention to provide improvements in the manufacture of spinnerettes.

Another object is to provide processes and tools for the manufacture of spinnerettes with orifice inserts.

Another object is to provide novel methods of mounting and securing inserts with predrilled orifices in spinnerettes.

Still another object is to provide methods of manufacture of spinnerettes with orifice inserts without distortion of the orifices.

Other objects will be apparent to those skilled in the art from the following description of the invention.

In the drawings:

FIGS. 1 and 2 show diametrical cross-sections of two embodiments of predrilled inserts which can be used in the practice of the invention.

FIG. 3 is a partial cross-sectional view of a spinnerette across a diameter of a predrilled aperture therein.

FIG. 4 illustrates one embodiment of a process for press-fitting an insert in the spinnerette with the press die of FIG. 5.

FIGS. 5–7 are side views of three embodiments of press dies which may be used to mount the inserts of FIGS. 1 and 2 in the spinnerettes.

FIGS. 8 and 9 illustrate two steps in the process of mounting an insert in a predrilled spinnerette aperture with the die of FIG. 7.

FIGS. 10 and 11 illustrate two steps in a process for mounting the insert of FIG. 2 in a predrilled aperture of the spinnerette with the die of FIG. 6.

FIG. 12 is a cross-section of a part of a spinnerette with the apertured insert securely mounted therein by the process illustrated in FIGS. 10 and 11.

The inserts of FIGS. 1 and 2 comprise an upper segment **20** and a lower segment **22**—both having cylindrical exterior surfaces. The interior of the inserts is a hollow cavity having a cylindrical wall **26** and a tapering, conical wall terminating in a spinning orifice or passage **24** at the apex thereof. In the embodiment of FIG. 2, the upper edge of the cylindrical wall **26** is interiorly beveled at **28**, **30** for a purpose later described. By way of illustration, the approximate dimensions of the inserts may be: diameter *a*, 1.00 mm.; diameter at *b*, the lower end of segment **20**, 1.60 mm.; and diameter at *c*, the upper end of segment **20**, 1.65 mm. It is to be noted that the exterior wall of segment **20** has a slight taper.

The spinnerette **36** of FIG. 3 has a predrilled aperture designated generally at **34**. The aperture constitutes three cylindrical cavities, **31**, **33**, **37** connected by tapered, conical walls **32**, **35**. In the example previously stated, the diameters of the cylindrical walls of the aperture **34** would be: *d*, 3.0 mm.; *e*, 1.625 mm.; and *f*, 1.05 mm. Because the diameter *e* is somewhat larger diameter than diameter *b* of the insert and diameter *f* is larger than diameter *a*, these portions have a sliding fit. In this manner, a deformation of the orifice opening **24** is avoided during the pressing in of the insert. However, a good sealing fit is assured because the diameter *e* corresponds to the mean diameter of the tapered wall of segment **20** of the insert.

For the pressing of the inserts into place, it is necessary to use special press dies, embodiments of which are shown in FIGURES 5, 6 and 7. FIG. 5 shows a form of a press die, whose part **40** fits into and is of equal or slightly smaller diameter than the cavity **31** of the predrilled spinnerette bore **31** of FIG. 3 and whose cylindrical guide **44** fits into the cylindrical cavity **26** of the insert of FIG. 1. By this conformation, the insert does not become canted as it is pressed into place by the shoulder **43** of cylindrical segment **42** of the press die pressed against the upper edge of the insert. The parts **40** and **44** of the die of FIG. 6 bear a similar relationship to the cavities **31** and **26**. However, segments **40** and **44** are connected by a tapered, conical segment **46** having a predetermined taper, later described in detail.

FIG. 7 shows a third form of a press die, by which, according to the invention, an additional insurance of a tight mounting of the insert is achieved. The guide **48**, in this instance, is not cylindrical as is guide **44** in FIGS. 5 and 6, but is terminally hemispherical, and the adjoining shoulder **52** of segment **50** is not diametrically planar, but rather has an angular, sloping surface slanting forwardly in an outward direction at an acute angle with respect to a diametric plane of the cylindrical portion. Also, the diameter of segment **50** is not equal to or slightly smaller than the outer diameter *c* of segment **20** of the insert of FIG. 1, but is somewhat larger, as, for example, 2.0 mm. for the former and 1.65 mm. for the latter.

In FIG. 8, the press die of FIG. 7 is shown in the starting position of operation. It is apparent that the angular sloping shoulder **52** is seated against the tapered wall **32** of the aperture in the spinnerette face **36**, while the

rounded guide **48** contacts the wall of cavity **26** of the insert **20, 22**. The flanging-in of the insert is accomplished by further travel of the die to the position of FIG. 9 where the nozzle plate metal is deformed and pressed inwardly over the upper edge of the insert by the angular, sloping shoulder **52**—giving an additional sealing and more securely holding the insert in the spinnerette as is shown in FIG. 9.

FIGS. 10 to 12 illustrate the corresponding operations if the insert of FIG. 2 and the press die of FIG. 6 are used. Here, too, as is apparent from the illustrations, with the complete pressing-in of the die, material of the spinnerette at the upper edge of cavity **33** is pressed over the bevel of the insert for additional sealing as a result of the differences in taper between segment **46** of the die and segment **32** of the spinnerette predrilled aperture.

The nozzle according to the invention assumes a special importance for nozzle openings with extremely small diameters under 125 mm. With the previous drilling process it was impossible to drill such fine holes, because, with the depth of the spinnerette faces being 8 to 35 mm., the fine drills, of necessity, were too long. The small depth of the insert according to this invention, maximum 3 mm. and preferably 1 mm., made possible the necessary shortening of the tools, in order to achieve the stability necessary for the production of accurately drilled, extremely fine bores. Furthermore, the invention allows an optical observation of the individual drilling operations, while in the drilling of plates with the 8–35 mm. depth mentioned it is only possible to drill blindly and by feel, without optical observation.

The invention is hereby claimed as follows:

1. A process for manufacture of spinnerettes which comprises drilling in a plate a series of three coaxial holes of progressively decreasing diameters; placing a hollow insert, having a cylindrical segment in the upper part of its inner wall, a pair of substantially cylindrical external walls of different diameters and a bottom wall extending across the cylindrical wall of smallest diameter with a predrilled spinning orifice in said bottom wall, in the two smallest of said series of coaxial holes; pressing with a press die having a cylindrical segment of slightly smaller diameter than the diameter of the largest of said coaxial holes, which segment thereby slides in guiding contact with the cylindrical wall of said last-mentioned hole, the insert into said two smallest of said holes with said cylindrical wall of smallest diameter of said insert in sliding, non-deforming engagement with the smallest of said series of coaxial holes and with the other of said pair of cylindrical walls of said insert in tight, deforming engagement with the wall of second most smallest diameter of said series of holes; guiding the position of said insert during the pressing thereof by said press die by engagement between a cylindrical wall segment on the working end of said press die and the cylindrical interior wall segment of said insert; and deforming by pressing with said die a portion of the wall in said series of holes adjacent the rearward end of said insert over the rearward end of said insert in the pressing operation by said press die.

2. A process of manufacturing spinnerettes which comprises drilling through a plate a plurality of connected, coaxial holes of progressively decreasing diameters; placing in said holes a hollow insert, having a cylindrical, external wall portion at its forward end, a bottom wall extending across said cylindrical wall with a predrilled spinning orifice in said bottom wall, and a rearward portion with an external wall portion which is of a diameter larger than the diameter of said cylindrical wall and which rearward portion has an aperture therethrough which is larger than the size of said spinning orifice; pressing with a press die against the upper edge of said hollow insert to press forwardly said insert into the smallest of said holes and the next larger of said holes with the cylindrical wall of said insert in sliding, non-deforming engagement with the smallest of said coaxial holes; and tightly seating said rearward portion of said hollow insert in said next larger of said coaxial holes during the pressing step with said pressing die.

3. A process of manufacturing spinnerettes which comprises drilling through a plate a plurality of connected, coaxial holes of progressively decreasing diameters with annular shoulders at the juncture of said holes; placing in said holes a hollow insert, having a cylindrical, external wall portion at its forward end, a bottom wall extending across said cylindrical wall with a predrilled spinning orifice in said bottom wall, and a rearward portion with an external wall portion which is of a diameter larger than the diameter of said cylindrical wall and which rearward portion has an aperture therethrough which is larger than the size of said spinning orifice and a shoulder between said external wall portion of said rearward portion and said cylindrical wall; pressing with a press die against the upper edge of said hollow insert to press forwardly said insert into the smallest of said holes and the next larger of said holes with the cylindrical wall of said insert in sliding, non-deforming engagement with the smallest of said coaxial holes until said shoulders are in contact with each other; and tightly seating said rearward portion of said hollow insert in said next larger of said coaxial holes during the pressing step with said pressing die.

4. In a process for mounting a hollow insert having a small spinning orifice at one end thereof and a larger aperture at the rearward end thereof in a predrilled spinnerette face having an aperture defining at least three hollow, cylindrical, coaxial cavities of decreasing diameter in a given direction with the walls of the cavity of second smallest diameter and the walls of the next adjacent larger cavity connected by a tapering wall, pressing said hollow insert with sliding, nondeforming engagenot between the exterior wall of said insert adjacent the spinning aperture and the inner wall of the cylindrical cavity of smallest diameter and with deforming, tight frictional engagement between the exterior wall of the rearward end of said insert and the inner wall of the cavity of second smallest diameter with a press die having a cylindrical surface at the working end thereof in engagement with the interior wall of said insert at the rearward end thereof and an enlarged cylindrical surface rearward of the working end thereof in sliding contact with a cylindrical interior wall of a cavity larger than said cavity of second smallest diameter, whereby said last-mentioned sliding contact keeps the press die in alignment with the cavities and said tapering wall is deformed inwardly over the rearward end of the insert by said die by means of a peripheral shoulder on said die slanting forwardly in an outward direction at an acute angle with respect to a diametric plane of the cylindrical portion.

5. The process of claim 2 wherein a portion of the interior wall of said coaxial holes adjacent the rearward end of the insert is deformed and pressed over the rearward edge of the insert by the die.

6. The process of claim 2 wherein the coaxial hole of second smallest diameter and a next adjacent, larger coaxial hole are connected by a tapering wall, and the portion of said tapering wall adjacent said coaxial hole of second smallest diameter is deformed inwardly over the rearward end of the insert by the die.

7. A process as claimed in claim 6 wherein said tapering wall is deformed inwardly over the rearward end of the insert by said die by means of a peripheral shoulder on said die slanting forwardly in an outward direction at an acute angle with respect to a diametric plane of the cylindrical portion.

8. A process as claimed in claim 6 wherein said die has a tapered portion of a more acute angle of taper than the taper of said tapering wall, and said die is pressed into said coaxial holes until said tapered portion of said die contacts said tapering wall and deforms in-

wardly the portion of said tapering wall adjacent the upper edge of said insert over said upper edge of said insert to tightly seat the upper portion of said insert in said next larger of said coaxial holes.

9. The process of claim 2 wherein said rearward portion of said hollow insert has a forwardly, slightly-tapered, outer surface which is tightly seated against the wall of said next larger of said coaxial holes.

10. A process of manufacturing spinnerettes which comprises drilling through a plate a plurality of connected, coaxial, cylindrical holes of progressively decreasing diameters; placing a hollow insert, having a cylindrical segment in the upper part of its inner wall, a pair of substantially cylindrical external walls of different diameters and a bottom wall extending across the cylindrical wall of smallest diameter with a predrilled spinning orifice in said bottom wall, in the two smallest of said series of coaxial holes; pressing with a press die against the upper

edge of said insert to press said insert into the two smallest of said holes with said cylindrical wall of smallest diameter of said insert in sliding, non-deforming engagement with the smallest of said series of coaxial holes and with the other of said pair of cylindrical walls in sliding engagement with the wall of second most smallest diameter in said series of holes; and tightly seating said other of said pair of cylindrical walls of said insert in said hole of second smallest diameter during said pressing with said press die.

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