Nov. 21, 1967 J. W. IJ. HEIJNIS 3,353,211

SPINNERET ASSEMBLY

Filed Dec. 29, 1965 2 Sheets-Sheet 1

FIG. 1

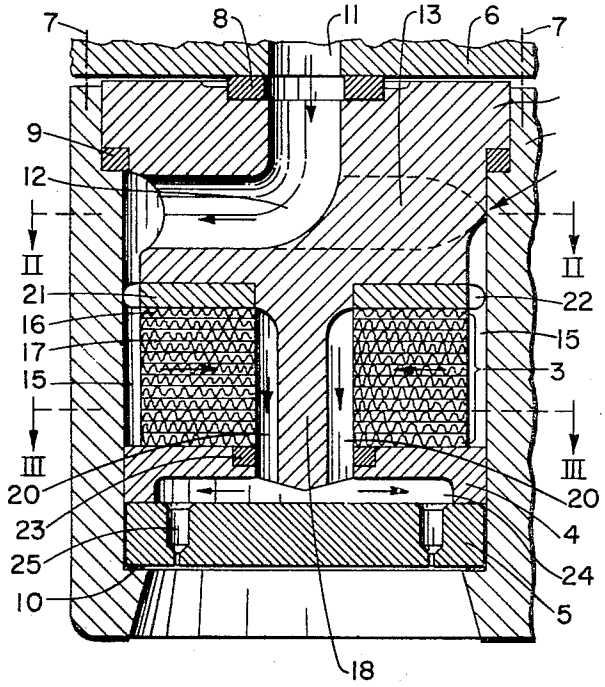


FIG. 2

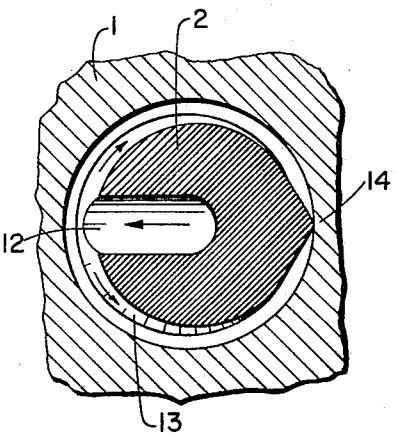
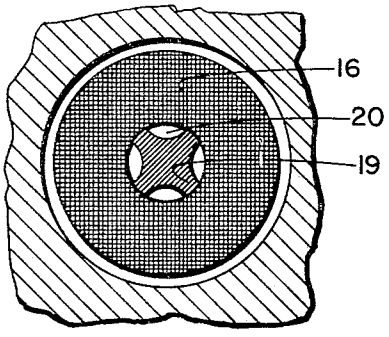


FIG. 3



INVENTOR.
JAMES W. IJ. HEIJNIS
BY
B. J. Johnson
AGENT

Nov. 21, 1967 J. W. IJ. HEIJNIS 3,353,211

SPINNERET ASSEMBLY

Filed Dec. 29, 1965 2 Sheets-Sheet 2

FIG. 4

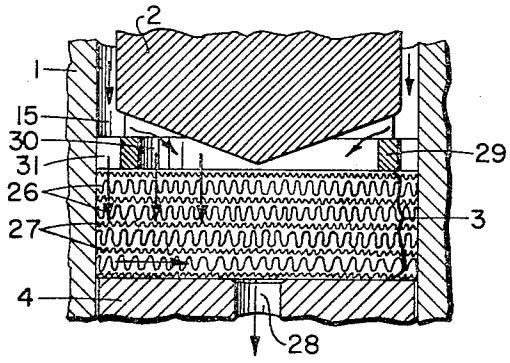
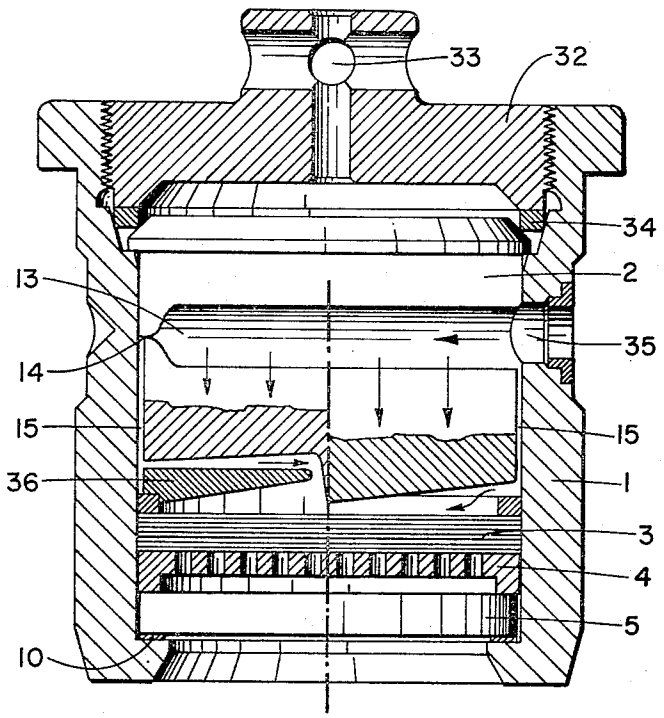


FIG. 5



INVENTOR.

JAMES W. IJ. HEIJNIS

BY

B. J. Johnson

AGENT

United States Patent Office 3,353,211 Patented Nov. 21, 1967

3,353,211

SPINNERET ASSEMBLY

James W. Ij Heijnis, Arnhem, Netherlands, assignor to American Enka Corporation, Enka, N.C., a corporation of Delaware

Filed Dec. 29, 1965, Ser. No. 517,250
Claims priority, application Netherlands, Jan. 6, 1965, 65—67
6 Claims. (Cl. 18—8)

ABSTRACT OF THE DISCLOSURE

A spinneret pack assembly embodying means for improving heat conductivity and sealing when subjected to polymer hydraulic pressure comprising, an inlet piece or "fill plug" within the assembly housing having a molten polymer flow conduit leading into a horizontally disposed molten polymer distribution channel which splits the molten polymer into two distinct patterns of flow, said channel extending almost entirely around the circumference of the inner wall of the assembly housing with the width thereof gradually narrowing both in a downward and horizontal direction. Novel means is also provided for centering a plurality of filter screens within the housing.

This invention relates to an apparatus for spinning artificial filaments; more particularly, the invention relates to an improved heat conducting spinneret pack assembly used in spinning filaments from thermoplastics.

In production of filaments from higher weight linear polymers, such as polyamides and polyesters, a melt of the polymer is usually fed to a spinneret pack assembly at very high pressure and at high temperatures from a conduit associated in some manner with a pressure screw mechanism or a metering pump. The spinneret pack assembly serves to prevent incompletely fused polymer, foreign matter, pigment aggregations, or aggregates of delustering materials or the like from reaching a spinneret plate which forms the polymer into filaments. To permit this, heated spinneret packs are conventionally used having a housing which is usually cylindrical in shape supporting and confining an inlet piece or fill plug, a series of filters, auxiliary devices such as melt distribution plates and supporting plates for a spinneret or spinneret plate through which the melt is extruded. The molten polymer is usually fed from the main feed conduit to the housing and through the sides thereof and the melt is further passed through a feed channel to the center of the inlet piece and is then centrally distributed downwardly the filter arrangement before being passed through the spinneret plate.

Disadvantages long associated with this type spinneret pack assemblies are that heat conduction between the heated housing to the melt in the center of the inlet piece is not satisfactory and air is sometimes entrained in the melt particularly at the beginning of the melt spinning process. Heat conductivity is a problem because of the distance between the interior of the housing sidewall and the continuously flowing molten polymer in the center of the inlet piece. Since the polymer does not directly flow along or across the primary heat conducting surface, uneven polymer heating and heat loss often occur. Air entrainment in the melt is a problem and is caused in these prior art devices primarily by methods used to pressure seal the apparatus to prevent polymer leakage. This problem is particularly great in spinnert packs which use a self-sealing expedient in an attempt to prevent undue polymer leakage from the spinneret assembly. In such a proposal, the inlet piece usually is spaced from the housing to permit movement therein. High pressures building up in these devices cause the piece to be pressed upwards to come in contact with a sealing ring which becomes deformed on contact with the piece. Uneven and fluctuating pressure acting on the element causes uneven deformation of the sealing ring and this leads to air seepage into the melt particularly in the clearance area between the inlet piece and the inner sidewall of the housing. Air gradually escapes from the spinneret plate in the form of small bubbles which cause filament breakage and results in yarn of inferior quality.

Accordingly, it is an object of this invention to provide a novel heat conducting type spinneret pack assembly which is used in spinning yarns and threads from polymeric substances.

Another object is to provide means which allow uniform heat distribution throughout the molten polymer passing through the novel spinning pack assembly.

A further object is to provide a novel spinning pack assembly wherein an inclusion of air with a molten polymer passing through the assembly is prevented.

In general, the above objects as well as additional advantages are obtained in accordance with this invention by providing within the spinneret housing, an inlet piece or "fill plug" having a melt entry conduit and distribution channel of a novel configuration. The novel inlet piece of this invention has a conduit leading into a horizontally disposed melt distribution channel which causes the melt to be split into two individual flow patterns. Such design permits an exceptional uniform melt distribtuion over a heat conducting housing interior sidewall and to the additional assemblies positioned below the channel. It allows direct contact of the polymer with the heated housing and the prevention of included air in the formed polymer. Included air is prevented by the developed back pressure of the polymer flow to and within the distribution channel and its even pressure distribution to sealing means employed in the assembly.

The foregoing will become more apparent to those skilled in the art upon study of the following description taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 shows, in longitudinal section, the spinneret pack assembly of the present invention showing a transverse melt filtration expedient;

FIGURE 2 is a section along the line II—II in FIGURE 1;

FIGURE 3 is a section along the line III—III in FIGURE 1;

FIGURE 4 shows an additional embodiment, in which the polymer filtration takes place both in the transverse direction and in the longitudinal direction; and

FIGURE 5 shows an additional embodiment.

In FIGURE 1 the numeral **1** refers to the cylindrical housing, which can be heated in any known manner (not shown). Provided in housing **1** is a spinning pack assembly which comprises, from the top downwards, fill plug or inlet piece **2**, a pack of filter screens or gauzes **3**, support plate **4**, and spinneret plate **5**. Provided on the housing **1** is closure or cap member **6** (part of which being shown), which can be fastened in any known manner, for example by bolts, which are indicated by a line **7**. When the bolts are tightened, the melt spinning apparatus will be completely sealed by pressure of the polymer being translated to sealing rings **8**, **9**, and **10**. Into closure **6** opens the main polymer feed conduit **11**, which is connected to channel **12** in inlet piece **2**. Near the circumference of inlet piece **2**, channel **12** opens directly into

the horizontally disposed distribution channel **13**, which encircles the assembly. The polymer melt, after entering distribution channel **13** from channel **12** at its sole port of entry, splits into individual streams and completely fills the distribution channel around its circumference. This permits creation of a back pressure in the melt which acts to break up or dissolve any existing gas bubbles within the melt before its reaching the filter pack. To create further back pressure, plus allow uniform melt flow substantially completely around the assembly, the channel gradually narrows in its longitudinal direction on each side of the melt point of entry from channel **12**. At **14**, which lies diametrically opposite this feed point, the width of the channel is zero.

As will be readily understood, it is possible to provide at least a portion of channel **13** in the adjoining wall of the housing; furthermore, it is possible to feed the melt into the distribution channel at a plurality of points, if desired.

Connecting along the entire lower circumference of distribution channel **13** is annular slot or circular space **15** which extends in downward direction between the housing **1** and inlet piece **2**. As shown in FIGURE 1, annular space **15** is, over the greater part of its vertical length, defined by the outer circumference of filter pack **3**. Filter pack **3** is made up of a series of superimposed filter gauzes or screens **16** which are in an alternating arrangement with metal plates **17**. Thus, between every two successive plates is a filter through which the melt must flow in a horizontal direction which acts to further blend in or break up any existing gas bubbles which may exist in the polymer melt. The grooved downwardly extending inlet piece stem **18** fits into a central bore of filter pack **3** and is provided with four ribs **19** distributed over its circumference, serving to positively center filter elements **16** and plates **17**. Grooves **20** between ribs **19** form channels through which the filtered melt flows to collecting space **24** and spinneret **5**. The direction of melt flow is indicated by the arrows. A centering ring support member **21** is provided with a number of centering extensions **22** for inlet piece **2**. Filter pack **3** is placed on stem **18** and enclosed between centering support **21** and a support plate **4**. Support plate **4** extends around the end portion of the stem support ring **23** which is composed of an elastic material such as rubber and the like. Channels **20** open into space **24** between supporting plate **4** and spinneret plate **5**. Numerals **25** represent the spinning orifices in the plate.

FIGURE 2, a plan view along lines II—II of FIGURE 1, shows the manner in which the polymer feed conduit **12** opens into the distribution channel.

FIGURE 3, a plan view along lines III—III of FIGURE 1, shows the filter pack arrangement surrounding inlet piece stem **18** and being positioned by ribs **19**.

FIGURE 4 shows a slightly modified embodiment of the apparatus according to this invention. The lowermost end of annular space **15** is shaped in a manner to permit the melt to be fed to filter pack **3** along its entire circumference as well as at the top. The filter pack in the embodiment is made up of a rather coarse-meshed filter screen **26**, which is alternated with a finer mesh filter screen **27**. The filter pack assembly is, in this assembly, like FIGURE 1, supported by plate **4**, having the centrally disposed polymer flow channel **28**. Plate **4** can be positioned directly on the spinneret plate (not shown). The filter pack is enclosed at its top by a circular plate **29**, having a central opening **30** and further having recesses **31** along its outer circumference. The melt flows through the filter pack both in vertical and horizontal direction (the direction of flow is indicated by the arrows), thus permitting a large, effective filtering surface for the melt. This permits the filter pack to be used for a longer period before it has to be replaced. The lower end inlet piece **2** is modified to permit the melt flowing

in downward direction from annular slot **15** to pass to the filter pack both through recesses **31** and bore **30**.

FIGURE 5 shows a cross-sectional view of an additional embodiment of the melt spinning apparatus according to this invention. Sealing against polymer leakage in this embodiment is effected by the pressure of the molten polymer passing through the housing. Top or closure **32** is screwed into the housing **1**. Between inlet piece **2** and closure **32** is a sealing ring or resilient gasket **34**. By its movement within the housing, the inlet piece exerts pressure directly on gasket **34** as soon as the melt enters the assembly and pressures begin to build. The assembly of this embodiment is the "top-loaded" type, which means that the assembly is lowered into a fixedly mounted, heated jacket for a spinning operation. Assemblies of this configuration permit easy replacement, for instance, after being in service for several weeks, the assembly can be easily removed, using lifting eye **33**, and replaced by a clean assembly. The main feed conduit for the melt is connected to opening **35** in the side of the housing in order to permit changing without completely shutting down the remaining chip melting and/or polymerization apparatus. Opening **35** feeds directly into distribution channel **13**, the width of which again decreases in the direction of the polymer flow. The melt flows from the distribution channel **13** downwardly through annular slot **15** defined by the arrangement of parts, in the direction indicated by the arrows. Beneath inlet piece **2** is filter pack **3**, through which the melt flows perpendicular to the plane of the arrangement of filters.

FIGURE 5 further shows, on each side of the broken line, two slightly different constructions of the lower end of inlet piece **2**. Left of the line shows an expedient wherein part of the polymer is guided by baffle means **36** from the wall of the housing to the center of the assembly and then is distributed over the filter. In the embodiment shown to the right of the line, the molten polymer flows from annular slot **15** directly to the filter. The filament arrangement and elements below are identical in both instances. Support plate **4** is provided with a series of openings through which the polymer passes to spinneret die plate **5**.

The invention in its broader aspects is not limited to the specific apparatus shown and described, but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

What is claimed is:

1. A spinneret pack assembly wherein both improved heat transfer and self-sealing of the pack is accomplished, comprising:

(a) a housing,

(b) a fill plug within the housing having at least one feed conduit for receiving a molten polymeric material from a pressurized source,

(c) said conduit directly communicating with a horizontally disposed distribution channel, a wall of which is formed by said plug downstream from said feed conduit,

(d) said channel further communicating along substantially its entire length with the interior wall of said spinneret housing,

(e) a filter pack interposed between said distribution channel and a spinneret plate, and

(f) said spinneret plate having a plurality of shaping orifices arranged to receive and shape the molten polymer into filaments.

2. Apparatus as defined in claim **1** in which the polymer melt distribution channel narrows in a longitudinal direction on each side of the point where said feed conduit communicates with said channel.

3. Apparatus as defined in claim **1** in which the fill plug is provided with a plurality of spacing members

distributed along its circumference to center the plug with respect to the spinneret housing.

4. A spinneret pack assembly comprising a housing, an inlet piece within the housing having at least one feed conduit adapted to receive a molten polymeric material from a pressurized source and having a projecting stem projecting from the bottom thereof, said stem having extending ribs for centering a plurality of filter screens disposed around said stem and a plurality of grooves between said ribs adapted to receive and guide the molten polymer to a spinneret plate.

5. Apparatus as defined in claim 1 in which the filter pack is composed of a plurality of alternating layers of screens having different mesh sizes.

6. Apparatus as defined in claim 1 in which the fill plug is adapted for movement within the housing when under the influence of pressure.

References Cited

UNITED STATES PATENTS

1,984,472	12/1934	Friederich et al.	18—8
2,560,778	7/1951	Richardson et al.	
2,784,843	3/1957	Braunlich.	
2,869,176	1/1959	Wright	18—8
2,871,511	2/1959	Speakman	18—8
2,881,474	4/1959	Sellers et al.	18—8

FOREIGN PATENTS

524,446	5/1956	Canada.
1,210,419	9/1959	France.
1,140,337	11/1962	Germany.

WILLIAM J. STEPHENSON, *Primary Examiner.*