June 23, 1964 H. KUSCH 3,137,895

ROTATING ATTACHMENT FOR EXTRUDING APPARATUS

Filed Jan. 3, 1962 3 Sheets-Sheet 1

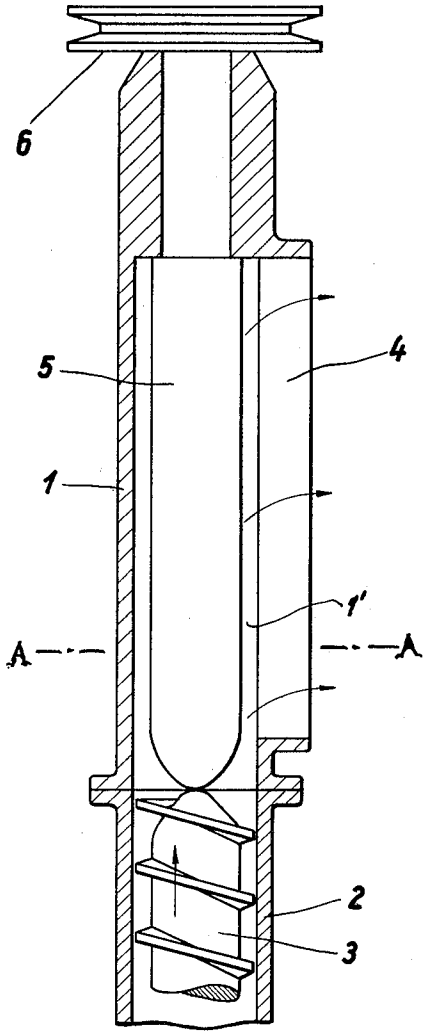

Fig. 1

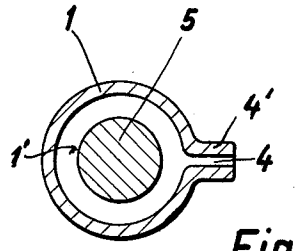

Fig. 2

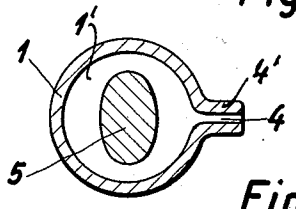

Fig. 3

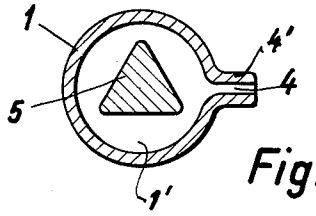

Fig. 4

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ROTATING ATTACHMENT FOR EXTRUDING APPARATUS

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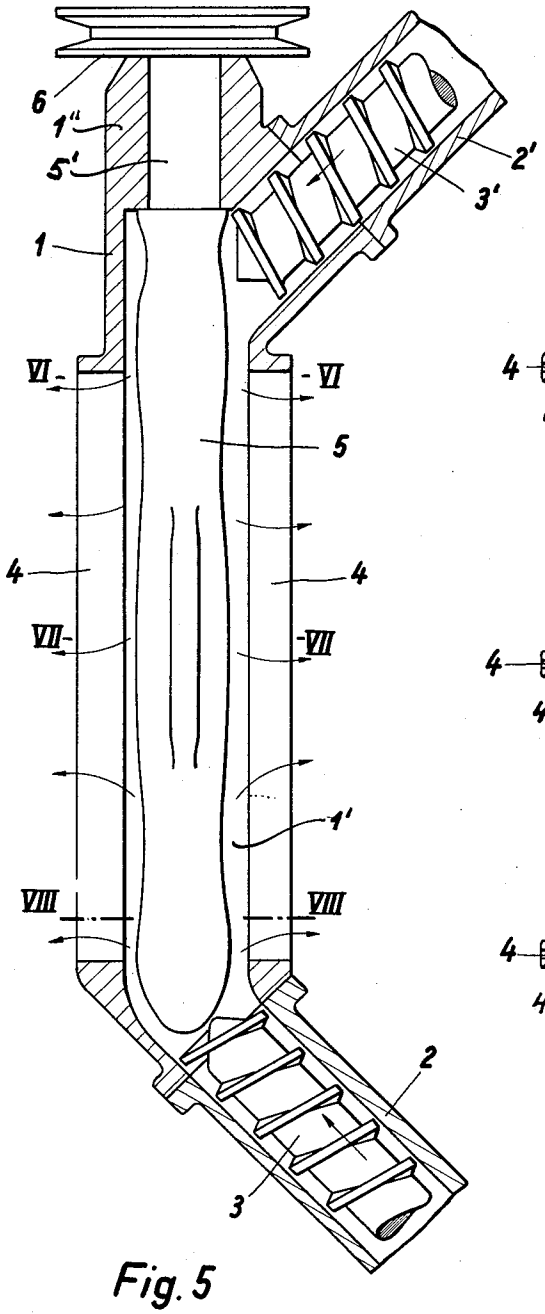

Fig. 5

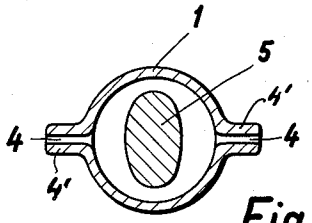

Fig. 6

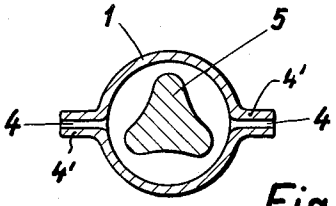

Fig. 7

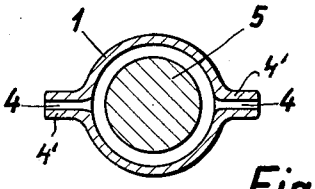

Fig. 8

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ROTATING ATTACHMENT FOR EXTRUDING APPARATUS

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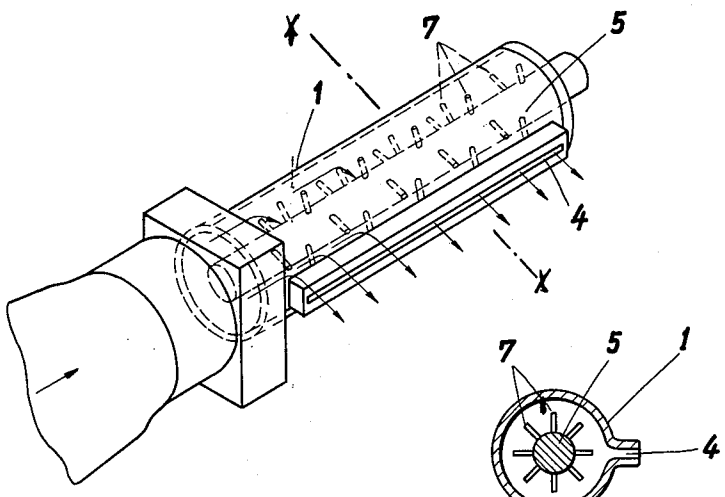

Fig. 9

Fig. 10

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United States Patent Office 3,137,895 Patented June 23, 1964

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ROTATING ATTACHMENT FOR EXTRUDING APPARATUS

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Filed Jan. 3, 1962, Ser. No. 164,011
Claims priority, application Germany Sept. 25, 1961
10 Claims. (Cl. 18—12)

My invention relates to a spinning device and more particularly to spinning nozzles adapted to be attached to extruding apparatus in the manufacture of ribbons, foils, sheets or the like from highly viscous thermoplastic and heat sensitive synthetic materials such as polyvinylchloride.

Known extrusion nozzles of said type comprise a cylindrical or conical spinning chamber provided with an elongated slot longitudinally extending in the chamber wall substantially in the direction of the axis of the chamber. The synthetic material to be processed is introduced under pressure by an extruding apparatus into said chamber to pass therethrough substantially in axial direction thereof and it emerges laterally from said chamber through said slot in the desired shape, such as a ribbon, foil, sheet or the like. These known spinning nozzles have the disadvantage that the material leaves the chamber of the nozzle in a completely uncontrolled manner causing substantial portions of material to remain in the chamber longer than others, this resulting in decompositions of unduly long retained material particularly if heat sensitive material is processed.

In the attempt to avoid said disadvantage it has been suggested to place in the nozzle chamber a rotatably mounted worm to supply spinning mass to the spinning slot. This provision, however, not only did not eliminate said disadvantage but added other disadvantages. The worm, which imparts to the mass in the nozzle chamber primarily a motion in its axial direction and increases the pressure within the chamber does not directly influence and particularly not accelerate a uniform exit of the mass through the spinning slot and thus the worm will rotate within the compressed mass in the spinning chamber causing strong adiabatic heating up of the mass and thus decompositions thereof. For this reason it has been suggested to substitute the said worm by a true mixing or stirring device extending along the spinning slot, such mixing device substantially consisting of mixing blades or pins radially extending to the wall of the spinning chamber from a rotatable shaft mounted in and coaxially with the spinning chamber.

However, even the aforesaid device was not fully satisfactory because the mixing blades or pins reaching to the wall of the spinning chamber obstructed the forward movement of the mass within the spinning chamber and this proved particularly damaging when long nozzles were used. Furthermore, spinning mass settled on the stirring blades or pins, particularly at their bases, requiring frequent cleaning of the nozzle.

It is an object of my invention to avoid the said and other disadvantages and to provide a spinning device, more particularly an extrusion nozzle for the manufacture of ribbons, foils, sheets or the like from highly viscous, heat sensitive thermoplastic synthetic materials such as polyvinylchloride, which will assure a continuous and uniform and smooth passage of the spinning mass through the elongated and narrow spinning slot.

According to my invention, particularly when the same is applied to the processing of heat sensitive thermoplastic synthetic spinning masses which does not need an additional substantial plasticizing and homogenization within

the spinning chamber, I place centrally into the spinning chamber a rotatably mounted mandrel or winding rod around which the spinning mass, introduced under pressure into the spinning chamber, winds in helically superimposed layers and, when passing the spinning slot penetrates therethrough under the pressure prevailing in the chamber. The said mandrel or winding rod may have a smooth, or a fully or partially rifled or serrated surface, it may have either a substantially uniform circular, oval, triangular, polygonal or other cross section, and such cross sections may vary throughout the length of the mandrel or winding rod which possibly may be provided with a plurality of regularly arranged, substantially radially extending short projections such as pins or horns which do not reach the inner surface of the chamber.

The spinning chamber within the nozzle may be in known manner cylindrical and/or conical and may be provided with more than one spinning slot. The spinning mass may be introduced into the spinning chamber at or near one or at or near both ends thereof. The said mandrel or winding rod may be driven directly by, or form an extension of the worm of the extruder feeding the spinning chamber, or it may be driven separately at the same or at different speed and direction. The spinning mass winding itself helically in superimposed layers on the mandrel or winding rod will not be unnecessarily long retained in the spinning chamber and will under the prevailing pressure uniformly and continuously enter into and pass through the spinning slot.

The said and other objects of my invention will be more fully understood from the following specification when read with the accompanying drawing in which several embodiments of my new device are illustrated.

In the drawing:

FIG. 1 shows a longitudinal, partly sectional view of my new extruding nozzle attached to the outlet of an extruder;

FIGS. 2, 3 and 4 show cross sections along line A—A in FIG. 1 of three different embodiments;

FIG. 5 shows a longitudinal partly sectional view of still another embodiment comprising two individually fed inlets to the nozzle and two spinning slots;

FIGS. 6, 7 and 8 are cross sectional views on lines VI—VI, VII—VII and VIII—VIII, respectively, of FIG. 5;

FIG. 9 shows a perspective view of an embodiment substantially identical with that shown in FIG. 1 however with a slightly modified mandrel or winding rod; and

FIG. 10 shows a cross sectional view thereof taken on line X—X of FIG. 9.

The same reference numerals indicate the same or equivalent elements.

The extrusion nozzle shown in FIG. 1 comprises a nozzle body **1** including a cylindrical spinning chamber **1'** and a longitudinally extending spinning slot **4** enclosed by lips **4'** which in known manner may be mutually adjustable to vary the width of said slot **4**.

The spinning chamber **1'** of this embodiment is open at one end and there attached to the cylinder **2** enclosing an extrusion worm **3** of an extruder. This worm **3** is rotatably driven in conventional manner and introduces under pressure a spinning mass into the spinning chamber **1'**.

Within this chamber **1'** is rotatably mounted a winding rod or mandrel **5** provided with a journal **5'** which rests in the end portion **1''** of the body **1** and is rotatably driven by a pulley **6** or in other known manner.

However, said winding rod or bobbin **5** may be an extrusion of the extruding worm **2** or be drivingly connected therewith. It may be shaped in many different ways; it may have a uniform circular (FIG. 2) or oval (FIG. 3)

or triangular (FIG. 4) or polygonal or any other suitable cross section, or it may have varying cross sections throughout its length as later described with reference to FIG. 5. Also, the spinning chamber **1** instead of being cylindrical as shown in FIG. 1 may be conical as known in the art, in which case the winding rod or mandrel **1** is accordingly conically shaped. The surface of the winding rod or mandrel **1** may be smooth, or uniformly or partially rifled or serrated. The spinning mass entering the spinning chamber **1** under pressure winds itself in helical layers upon the winding rod or mandrel **1** and does not form any dead zones retaining the mass for a dangerously long time, thus avoiding decompositions thereof.

As shown in the drawing the winding rod or mandrel **5** has a substantially sized diameter compared to the diameter of the spinning chamber and thus a relatively great surface to engage the spinning mass for causing the same to wind around in helical layers. The width of the channel longitudinally extending in the spinning chamber between the winding rod or mandrel and the inner surface of the nozzle body **1** may be made as narrow as desired, however, it has to be wide enough not to disturb the winding of the helical layers around the winding rod or mandrel and not to obstruct passage of the spinning mass in longitudinal direction of spinning chamber and along the spinning slot **4**. The rotational speed of the winding rod or mandrel may have to be changed for different spinning masses in accordance with their specific viscosity.

If my new nozzle is used, for example, for processing polyvinylchloride then a preferred embodiment will show a ratio of about 4:5:75 between the diameter of the cylindrical winding rod or bobbin, the diameter of the cylindrical spinning chamber, and the lengths of said chamber and the substantially equally long spinning slot. The winding rod or mandrel rotates at about 30 to 40 revolutions per minute and the temperature in the spinning chamber is held at about 200° C.

In the embodiment shown in FIG. 5, already shortly referred to above, the spinning chamber **1'** within the nozzle body **1** is provided at or near its ends with two inlet openings for feeding the spinning mass thereinto by the extrusion worms **3, 3'** of extruders **2, 2'**, respectively, and also with two spinning slots **4, 4'**. The winding rod or mandrel **5** shows varying, but smoothly merging cross sections for example as shown in FIGS. 6, 7 and 8.

In most cases a winding rod or mandrel having a smooth surface will work satisfactorily to cause the highly viscous opening mass to wind around. As stated above, the surface of the winding rod or mandrel may however, be fully or partially rifled or serrated, or it may as shown in FIGS. 9 and 10 be provided with substantially radially extending projections **7**, such as pins or horns or the like.

While specific embodiments of my invention have been shown and described in detail to illustrate the application of the principles of my invention, it will be well understood that the same may be otherwise embodied without departing from said principles and without avoiding the scope of the appended claims.

What I claim as my invention is:

1. A spinning attachment for extruding apparatus in the manufacture of ribbons, foils, sheets or the like from heat-sensitive viscous synthetic raw material, comprising in combination a substantially cylindrical chamber open at one end to receive compressed raw material from the extruding apparatus and closed at the other end; an elongated spinning slot in said chamber extending in axial direction thereof; and a winding rod or mandrel rotatably mounted in said chamber and substantially coextending longitudinally therewith, said winding rod or mandrel while rotating causing the spinning mass to wind around in helical layers and to enter the spinning slot uniformly and continuously under the pressure prevailing in the chamber.

2. A molding die attachment for extruding apparatus in the manufacture of foils or sheets from heat-sensitive viscous synthetic raw material, comprising in combination a substantially conical chamber open at its wide end to receive compressed raw material from the extruding apparatus and closed at the other end; an elongated spinning slot in said chamber extending in axial direction thereof, and a conical winding rod or mandrel rotatably mounted in said chamber and substantially coextending therewith, said winding rod or mandrel while rotating causing the spinning mass to wind around in helical layers and to enter the spinning slot uniformly and contiuously under the pressure prevailing in the chamber.

3. A spinning attachment according to claim 1 wherein the winding rod or mandrel has a uniform non-circular cross section.

4. A spinning attachment according to claim 2 wherein the winding rod or mandrel has a uniform non-circular cross section.

5. A spinning attachment according to claim 1 wherein the winding rod or mandrel has at least two different cross sections said cross section smoothly merging one into the other.

6. A spinning attachment according to claim 2 wherein the winding rod or mandrel has at least two different cross sections said cross section smoothly merging one into the other.

7. A spinning attachment according to claim 1 in which the winding rod or mandrel is at least partially rifled or serrated.

8. A spinning attachment according to claim 2 in which the winding rod or mandrel is at least partially rifled or serrated.

9. A spinning attachment according to claim 1 comprising a plurality of projections radially extending from said winding rod or mandrel without reaching the inner surface of the chamber.

10. A spinning attachment according to claim 2 comprising a plurality of projections radially extending from said winding rod or mandrel without reaching the inner surface of the chamber.

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