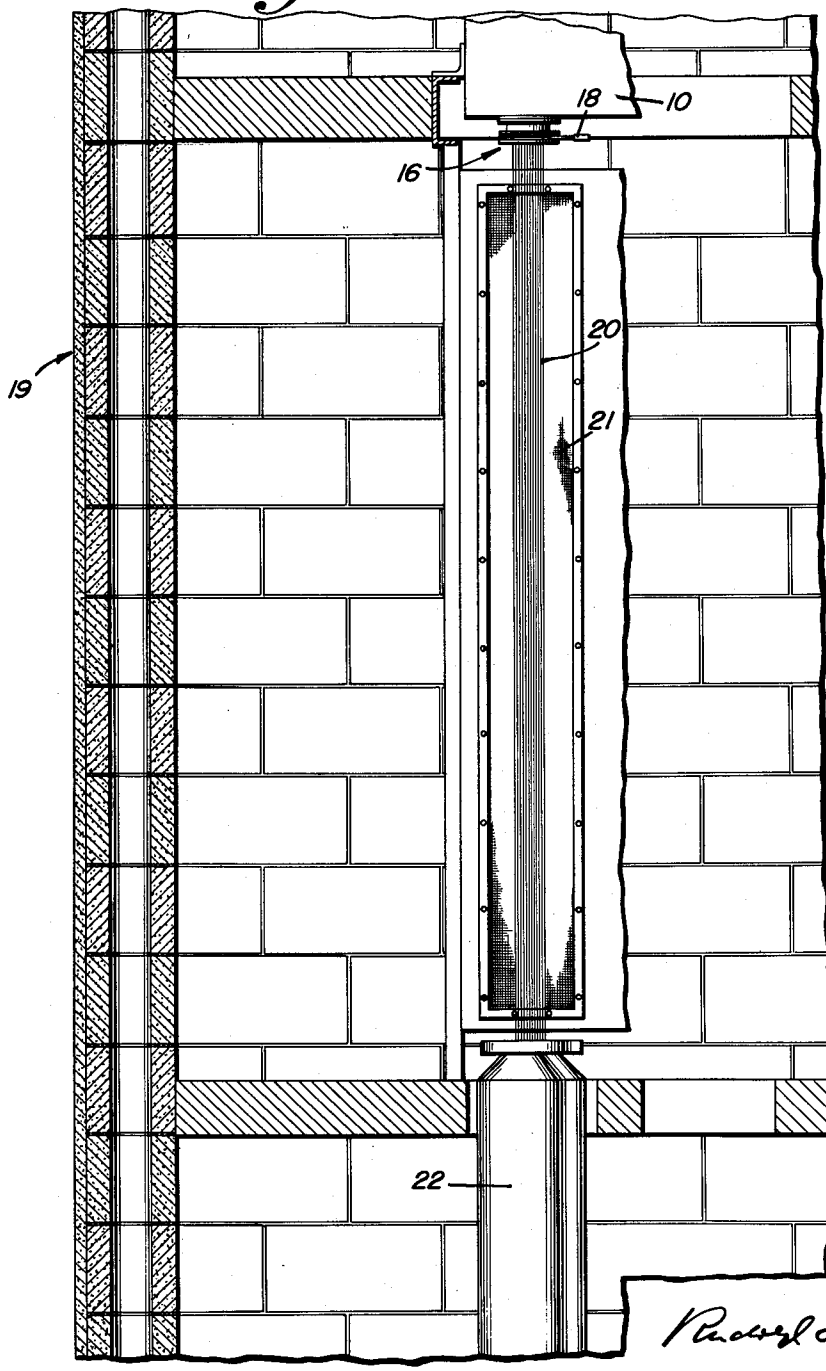
March 12, 1963 R. S. BLEY 3,080,607

MELT SPINNING APPARATUS

Filed Jan. 28, 1957 4 Sheets-Sheet 1

Fig. 1A



INVENTOR

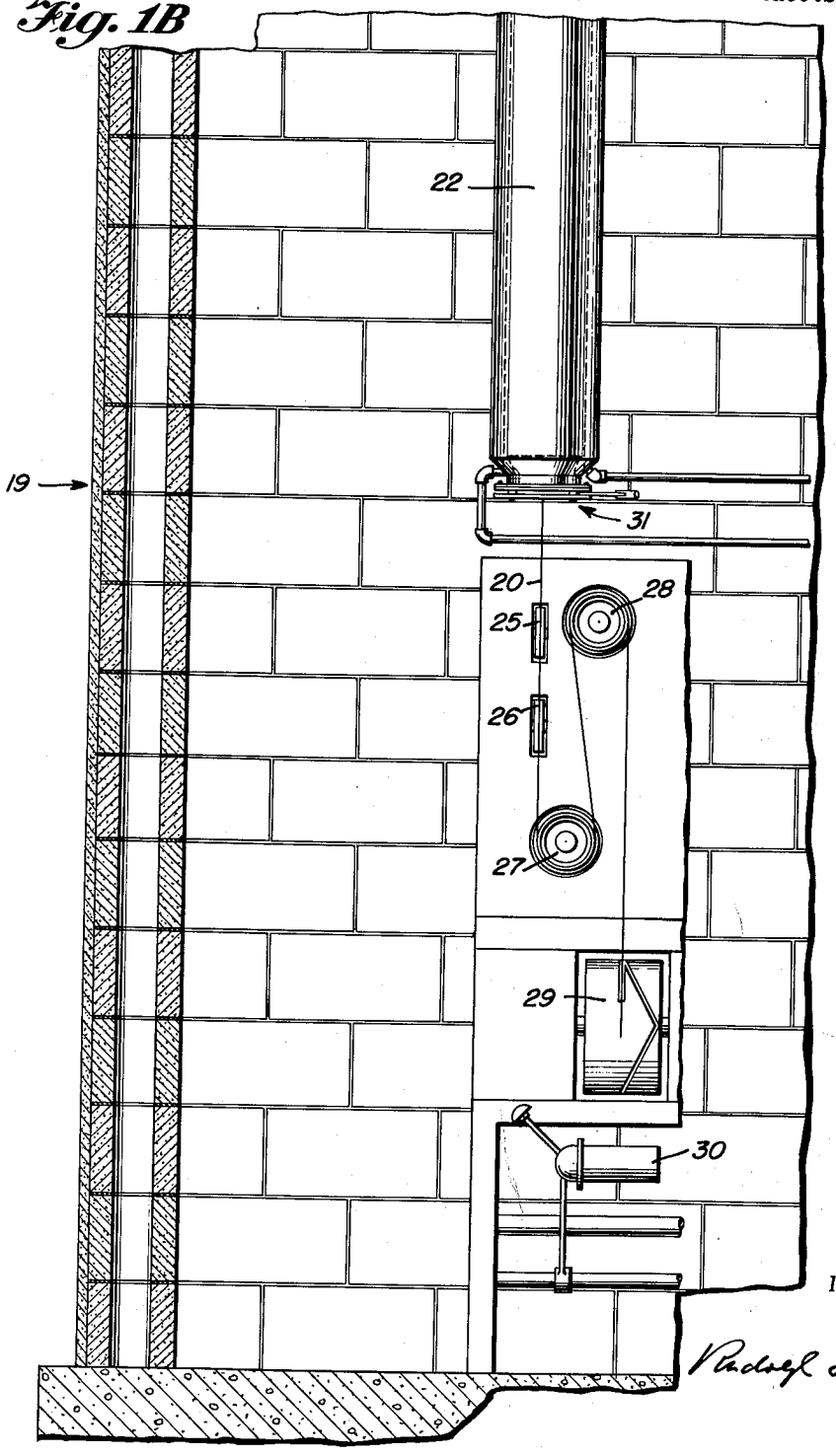
Richard S. Bley

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MELT SPINNING APPARATUS

Filed Jan. 28, 1957 4 Sheets-Sheet 2

Fig. 1B



INVENTOR

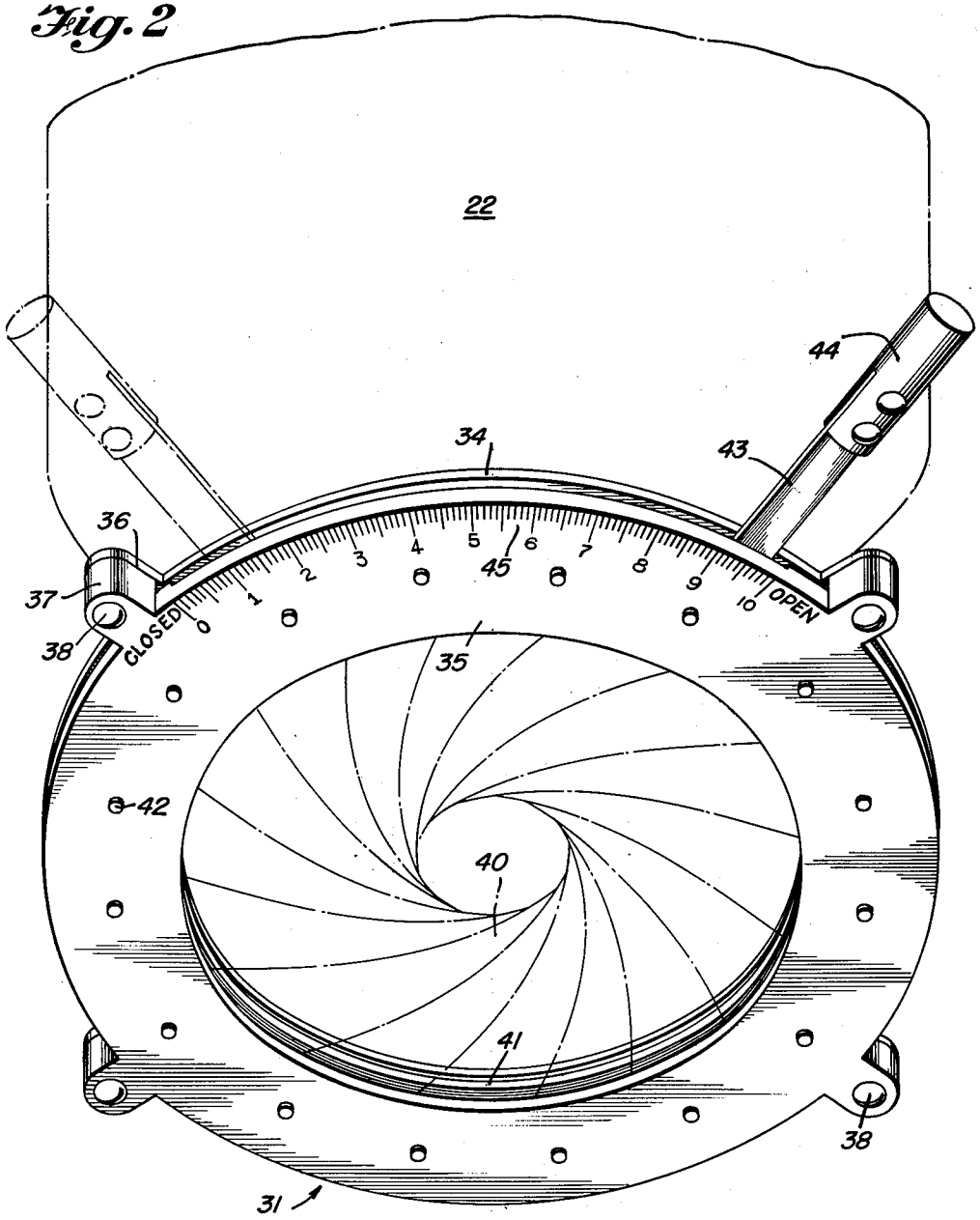
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Fig. 2



INVENTOR

Richard S. Bley

March 12, 1963 R. S. BLEY 3,080,607

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Fig. 3

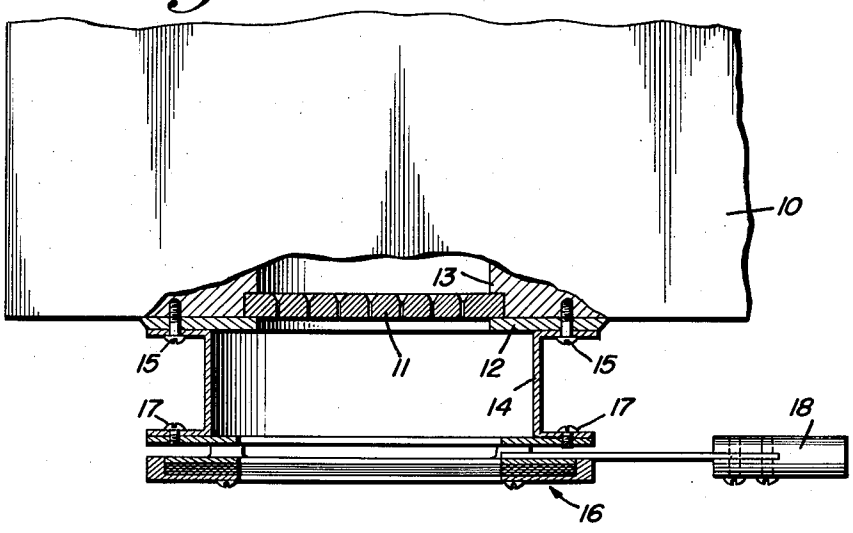
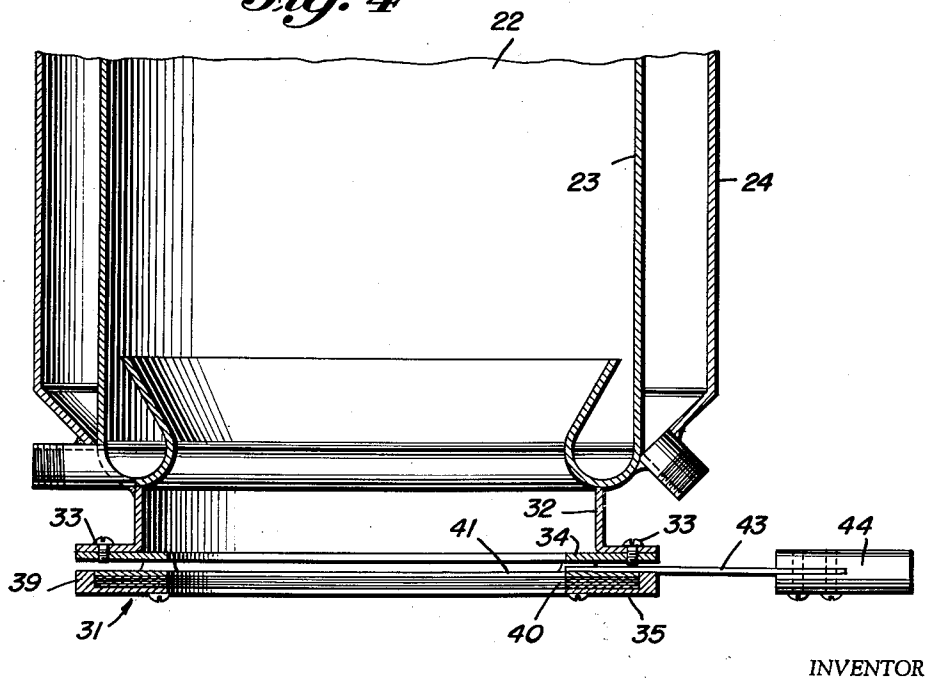


Fig. 4



INVENTOR

Randolph S. Bley

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3,080,607

MELT SPINNING APPARATUS

Rudolph S. Bley, Milligan College, Tenn., assignor to Beaunit Mills, Incorporated, New York, N.Y., a corporation of New York

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5 Claims. (Cl. 18—8)

The present invention relates to apparatus for the melt spinning of polyamids such as nylon 6, nylon 66, etc., polyesters such as Dacron and other organic filament-forming compositions.

The method of producing synthetic fibers by what is known as the melt spinning process has been practiced commercially for a number of years. In general the method entails pumping a molten filament-forming composition through a downwardly directed spinneret having from one to several hundred minute orifices, allowing or forcing the newly formed filaments to cool and solidify as they drop by gravity for a substantial distance, collecting the filaments into a thread in the cases where more than one orifice is employed and winding the thread into a package. There is a small amount of drawing or stretching of the filaments due to their weight as they fall from the spinneret but the thread is normally subjected to its main drawing operation subsequent to the initial packaging.

While it is desirable to allow the filaments to cool gradually during a comparatively long drop, say fifteen feet or more, from the spinneret rather than attempt to force the cooling to take place in a short distance, hitherto considerable difficulty has been encountered in maintaining a uniform or constant denier of the filaments, both in those cases where a long drop is employed and in the case where cooling is forced to take place during a comparatively short drop. This non-constant or uneven denier is highly objectionable in that it affects the dyeing characteristics, drawability, etc. of the yarn or thread. The uneven denier is caused in the case of a long drop of the filaments by air currents which tend to buoy up the extremely light-weight filaments or sway them from a straight-line path so that they do not drop at a constant rate and consequently do not stretch evenly.

Another difficulty encountered in melt spinning has been a tendency for the newly formed filaments to turn back against the lower face of the spinneret and this results at first in uneven denier and eventually in broken filaments.

It is the general object of the present invention to provide melt spinning apparatus which produces thread and yarn of constant denier.

It is a more particular object of this invention to provide melt spinning apparatus wherein the newly formed filaments during their free fall from the spinneret are protected from undesirable air currents which would tend to disrupt the free fall of said filaments and consequently produce filaments of non-uniform denier.

It is a further object of the invention to provide melt spinning apparatus wherein the tendency for the newly formed filaments to turn back against the face of the spinneret is substantially reduced.

These and further objects, features and advantages will become apparent as the description of a preferred embodiment of the invention proceeds.

Referring now to the drawings:

FIGURE 1A is an elevational view of the upper portion of a melt spinning apparatus embodying the invention and showing same housed in a building,

FIGURE 1B is a continuation of FIGURE 1A and shows the lower portion of the apparatus,

FIGURE 2 is a perspective view of an iris diaphragm

located at the lower end of the apparatus and forming an element of the present invention,

FIGURE 3 is a sectional view of the spinneret and shows an iris diaphragm located closely therebeneath in accordance with the present invention, and

FIGURE 4 is a vertical sectional view of the parts shown in FIGURE 2.

The filament-forming composition, such as a polyamid, polyester, etc. is contained in molten form in a tank partially indicated at 10, from which it is pumped by any suitable means through a downwardly directed spinneret 11, see FIG. 3. The spinneret is secured in position by means of a plate 12 which holds it against a shoulder 13 provided in the bottom of the tank 10. With this arrangement the spinneret may rapidly be changed to permit the spinning of threads of different denier and having from one to several hundred filaments.

As shown in detail in FIG. 3, a flanged collar member 14 is located directly beneath the spinneret and is secured to the bottom of tank 10 by means of screws 15 which also serve to hold the plate 12 in position. An iris diaphragm generally designated 16, of usual construction, as will be explained later, is secured by means of screws 17 to the bottom flange of the collar member 14. A handle 18 is provided for manual adjustment of the opening through the iris diaphragm. In FIG. 3, the iris diaphragm is shown in its fully open condition but in operation said diaphragm is adjusted by means of the handle 18 so that its central opening is just sufficiently large to accommodate the filaments being extruded through the spinneret—the particular adjustment of the diaphragm thus depending upon the arrangement of the orifices in the spinneret. The purpose of the collar member 14 and iris diaphragm 16 is to protect the lower face of the spinneret from drafts which would tend to cause the newly formed, still molten, filaments to turn back toward the spinneret and contact the face thereof. This contacting of the face of the spinneret at first causes uneven denier of the filaments and eventually results in the breakage thereof.

In order to give an indication of the size of the apparatus and the distance traveled by the fibers after leaving the spinneret, the apparatus is shown housed in a building generally designated 19 and from FIGS. 1A and 1B it will be seen that the bottom of the tank 10 is located approximately at the ceiling of the second story of the building. The fibers are indicated at 20 and, as shown in FIG. 1A, as the newly spun fibers issue from the spinneret and move below the iris diaphragm 16 they fall freely from the ceiling to the floor of the second story, a distance of a little less than nine feet. During this initial drop, the fibers pass in front of a fine-mesh screen 21 through which cool air is blown to aid the cooling and solidification of the fibers. The fine mesh of the screen 21 prevents the air from striking the fibers with such a great force as to materially divert said fibers from their free verticle fall.

As the fibers approach the floor of the second story of the building they enter the top of a vertically arranged tubular member 22. As shown in FIG. 4, the tubular member 22 has an inner wall 23 and an outer wall 24 so that at times said member may be heated or cooled by circulating an appropriate medium between the two walls, depending upon the type and denier of the yarn being spun. A suitable collecting ring not shown is located in the lower end of the tubular member 22 or just below said tubular member for the purpose of bringing the individual filaments close together into a single strand as is shown emerging from the bottom thereof in FIG. 1B. When the strand leaves the bottom of the tubular member 22, the filaments have cooled and completely solidified so that the strand is ready to be wound into a package and

thus, as shown diagrammatically in FIG. 1B the strand is passed over a pair of rollers 25 and 26 where a finishing material is applied and then around a pair of godets 27 and 28 where a very slight amount of stretch is applied and on to a traversing guide 29 and a winding drum 30.

The tubular member 22 is about five feet long and since it extends vertically from the first story of the building through the floor of the second story it acts somewhat in the manner of a chimney inasmuch as air tends to flow upward therethrough. The upward movement of air through the tubular member is highly undesirable in that such movement of air tends to buoy up the extremely light-weight filaments and prevent the desired uniformr rate of descent and consequent uniform stretching, which as previously mentioned, is necessary if cloth made from the yarn is to have satisfactory dyeing properties. Such air flow may be minimized by having the opening in the bottom of the tubular member as small as possible to accommodate the passage of the filaments therethrough. However the bottom of the tubular member cannot be permanently restricted because at the beginning of the spinning operation the filaments must be threaded through said tubular member. In practice, at the beginning of the operation, the top of tubular member 22 is closed, as by placing a piece of cardboard or the like over it. As the filaments drop into the cardboard from the spinneret, they are allowed to accumulate into a mound or wad until there is a wad of sufficient weight that an operator on the second floor of the building can drop the wad through the tubular member to an operator on the first floor who then cuts the wad loose from the oncoming strand and threads said strand over rollers 25 and 26 and the godets 27 and 28 and around a core placed on the winding drum 30.

The present invention provides means for restricting the bottom opening of the tubular member 22 after the wad of filaments has been dropped therethrough and the spinning operation is underway. For this purpose, an iris diaphragm generally designated at 31 and best shown in FIGS. 2 and 4 is provided. A flanged collar 32 is welded or otherwise secured to the bottom of tubular member 22 and the iris diaphragm is secured to the flange of said collar by means of screws 33, see FIG. 4.

The iris diaphragm 31 is similar in construction to the iris diaphragm 16 and comprises a pair of flat rings 34 and 35 having a plurality of outwardly extending projections 36 and 37 respectively, the projections 37 being thicker than the ring 35 of which they are a part. Rings 34 and 35 are held together by screws 38 which pass through the projections 36 and 37, the thickened projections 37 serving to space said rings apart. As seen in FIG. 4, the lower ring 35 is provided with a flange 39 and the usual array of diaphragm plates 40 and an operating ring 41 are located within the confines of said flange. The plates 40 are each pivotally connected at one end to the ring 35 as by means of pins 42 shown in FIG. 2 and at their other ends are articulated to the operating ring 41. An arm 43 connected to the operating ring 41 extends outwardly therefrom and is provided with a handle 41 by means of which the iris diaphragm may be selectively opened and closed. As shown in FIG. 2, a scale 45 is provided to aid the operator in positioning the handle 44 so as to provide the optimum opening of the diaphragm for spinning various types of yarn. The optimum opening is the one which is just large enough to permit a small amount of lateral movement of the yarn strand and at the same time prevent as much as possible the entry of air into the bottom of the tube.

Having thus described a preferred embodiment of the invention, what is claimed is:

1. Apparatus for spinning molten organic filament-forming compositions comprising a downwardly directed spinneret through which the molten composition is pumped to form filaments, a collar extending for a short distance below said spinneret, means for adjustably restricting the lower end of said collar, a vertically extending tubular member aligned with said spinneret and said collar whereby the filaments fall by gravity therethrough, and means for adjustably restricting the opening in the lower end of said tubular member to a size only sufficiently large to accommodate the filaments.

2. Apparatus of claim 1 in which at least one of the adjustable restricting means is a variably settable iris diaphragm.

3. Apparatus of claim 2 having means for indicating the proper iris diaphragm adjustment for different spinning conditions.

4. Apparatus for spinning molten organic filament-forming compositions comprising a downwardly directed spinneret through which the molten composition is pumped to form filaments, a collar extending for a short distance below said spinneret, means for adjustably restricting the lower end of said collar, filament cooling means disposed below said collar, a vertically extending tubular member aligned with said spinneret and said filament cooling means whereby the filaments fall by gravity therethrough, and means for adjustably restricting the opening in the lower end of said tubular member to a size only sufficiently large to accommodate the filaments.

5. Apparatus of claim 4 in which at least one of the adjustable restricting means is a variably settable iris diaphragm.

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