April 23, 1957 C. PISTOR ET AL 2,789,315

WET SPINNING APPARATUS

Filed June 26, 1953 2 Sheets-Sheet 1

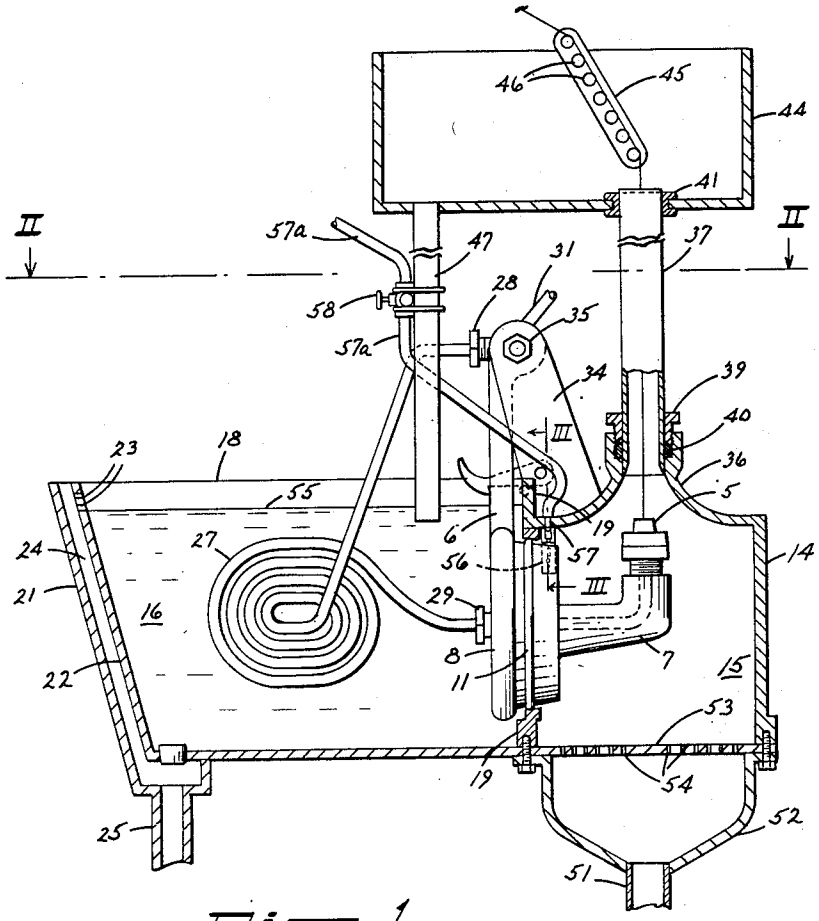


Fig. 1

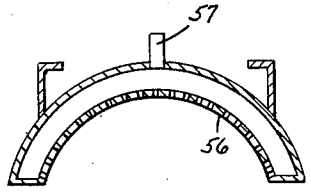


Fig. 3

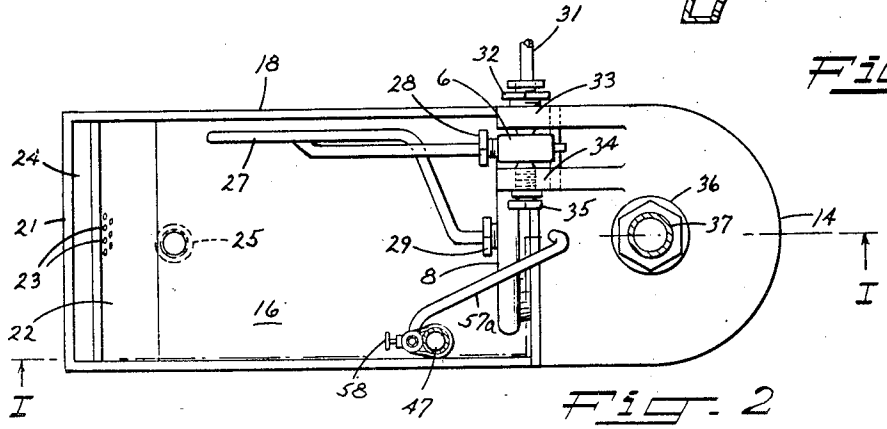


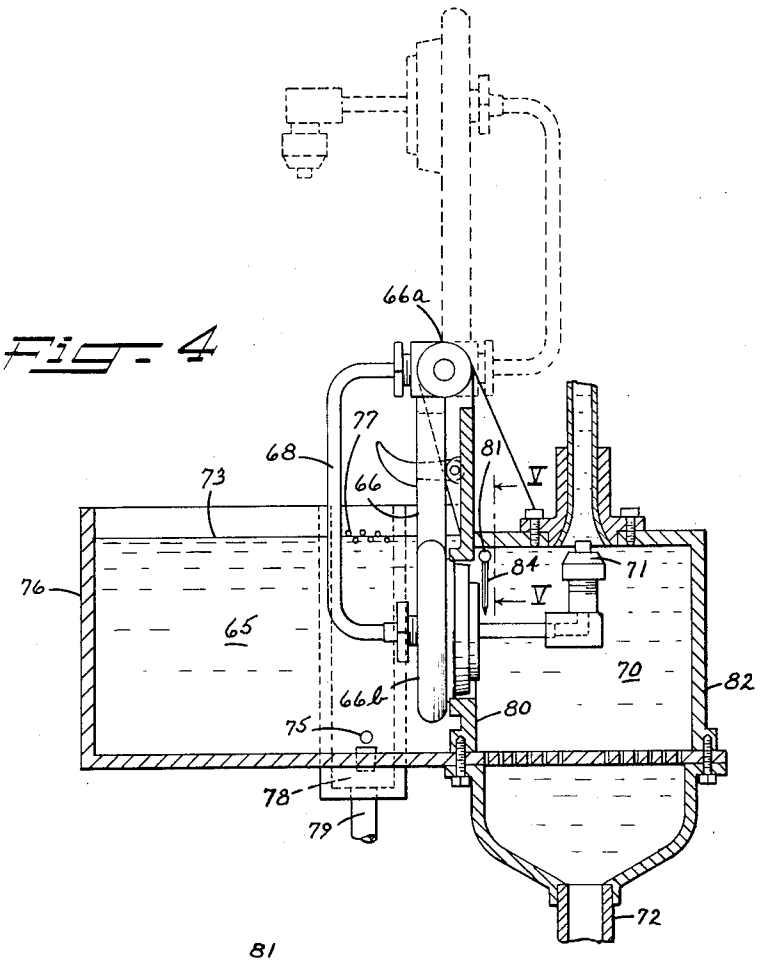
Fig. 2

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WET SPINNING APPARATUS

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Fig. 4



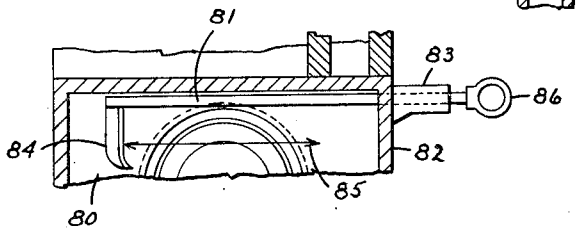


Fig. 5

United States Patent Office 2,789,315 Patented Apr. 23, 1957

2,789,315

WET SPINNING APPARATUS

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Application June 26, 1953, Serial No. 364,294

10 Claims. (Cl. 18—8)

The present invention relates to systems for extruding liquid filament-forming materials and particularly to systems wherein one of such materials may be spun into a liquid coagulant at a submerged position within a chamber and then discharged through a duct having an entrance within the chamber below the surface of the coagulant, the strand then issuing from the duct in coagulated condition as a strand traveling concurrently with the coagulant.

A problem in operating spinning apparatus of this type is that of starting the extrusion of material through the spinneret and thereupon successfully coagulating the material and lacing it through the tube without any fouling of the spinneret. Moreover, it is necessary to produce an extruded product free from small masses of coalesced material so that the resulting yarn will pass readily through guides in progressing through and to succeeding treatments. Where spinning is performed in a closed chamber from which the extruded material is discharged upwardly from an upwardly-facing spinneret, the problem is particularly troublesome because the spinneret is necessarily subjected to the pressure corresponding to the height of the coagulant necessary to carry the strand or extruded product upwardly through the spinning tube. Therefore, if the spinneret is placed in the operating position without a coagulatable filament-forming material passing therethrough, and the flow of coagulant is started before the filament-forming material is supplied to the spinneret, then the coagulant is likely to enter the orifices of the spinneret. Consequently, when spinning or extrusion is attempted, coagulum may be formed within the orifices or behind the face of the spinneret whereupon the spinneret becomes fouled. If extrusion is commenced before the flow of coagulant is started, the extruded material flows back upon the face of the upwardly-facing spinneret. If an extruded substance is sticky, as is the case with viscose solution, the spinneret may be fouled if the extruded material is allowed to flow back on its face. Moreover, any material extruded into the spinning chamber before the flow of coagulant is started usually collects in masses which when later caught by the current of coagulant may be floated about the chamber and the spinning tube and thus become attached to the strand being formed therein. Such masses attached to the strand, which at this stage is in a nascent condition, or any enlarged portions of the strand, may cause breakage of the filaments in attempting to pass through a guide having a restricted passageway.

It is an object of the present invention to provide a readily laceable apparatus for spinning a filament-forming material into a coagulant or filament-hardening liquid in which the spinneret of the apparatus faces upwardly in a closed spinning chamber. Objects ancillary to the foregoing object are to effect the transfer of the spinneret from a non-operating position outside the chamber to its operating position whereupon the extruded material may be instantly threaded through a discharge tube, and to coagulate any strand-forming material discharged from the

spinneret prior to reaching the operating position. A further object is to provide a chamber for preheating the strand-forming liquid before the extrusion thereof in apparatus, such chamber being additional to a closed chamber employed in carrying out the above-named objects. Other objects, features, and advantages will become apparent from the following description of the invention and the drawings relating thereto in which

Fig. 1 is a shortened elevation, partly in section, as taken along line I—I of Fig. 2 illustrating one embodiment of spinning apparatus in accordance with the invention;

Fig. 2 is a view, partly in section, taken along line II—II of Fig. 1;

Fig. 3 is a sectional view of a fluid-distributor taken along line III—III of Fig. 1;

Fig. 4 is an elevation, partly in section, illustrating another embodiment of the invention; and

Fig. 5 is a fragmentary section taken along line V—V of Fig. 4 illustrating in greater detail a strand-severing member.

In brief, the invention concerns spinning apparatus comprising a spinning chamber, an open-top chamber in lateral disposition therewith and having a wall, preferably a wall in common with the spinning chamber for separating the chambers, and a spinneret mounted on a pivotable member with the pivotal axis thereof disposed for swinging the spinneret from a position above the open-top chamber through an opening in the wall into normal operating position within the spinning chamber. The pivotable member has a closure portion adapted to close the opening when the spinneret is disposed in operating position. When the spinneret is aligned relative to the member so that it assumes its normal spinning position within the spinning chamber, it faces into a spinning tube extending from interiorly of the spinning chamber upwardly to a region above the spinning chamber. The open top chamber is adapted to receive liquid from the spinning chamber through the opening and fill to a liquid level which submerges the opening when the closure portion of the member is not in place thereover. The open-top chamber may be further adapted to either sustain the desired level or to permit drainage of the open-top chamber following the positioning of the spinneret and the closing of the opening for normal operation.

Proceeding now to details in the construction and operation of the embodiment of the apparatus illustrated in Figs. 1 and 2, a filament-forming material, such as viscose solution, is extruded through a spinneret **5** supported by a pivotable arm **6** and an extension **7** thereof. The arm has a closure portion **8** provided with a groove into which fits a resilient ring **11**. The closure portion seats within the opening or port extending through a lateral wall of a housing **14** defining the chamber **15**. The ring **11**, partly contained within the groove of the closure **8**, engages the periphery of a lateral opening of the chamber **15** to seal it from communication with a chamber **16** disposed interiorly of the container **18**. The container **18** and the housing **14** have a common wall **19** in which the opening which receives the closure **8** of the arm **6** is formed. The container **18** has a pair of spaced walls **21** and **22**. The wall **22** has a plurality of apertures **23** extending through an upper portion thereof which determines the overflow level for liquid collected in the chamber **16**. A plurality of small apertures, such as apertures **23**, are preferred for passage of liquid from the chamber **16**, so that any material discharged from the spinneret and coagulated during the lacing operation, may be retained in the chamber **16** and removed, and thus prevented from entering a drainage system for the coagulant. The space **24** between the walls **21** and **22** provides a passageway **24** contiguous with the passageway of a drainage duct **25** by

which liquid overflowing from the chamber may be led away from a spinning apparatus.

During normal operation of the apparatus with the spinneret disposed as shown in Figs. 1 and 2, the chamber **16** has disposed therein a coiled tube or rounder **27** of which the ends thereof are connected to different portions of the arm **6** by couplings **28** and **29**. The coils of the tube **27** are preferably disposed substantially below the level of the apertures **23** whereby the tube may function more efficiently as a heat exchanger to transfer heat from the liquid in the chamber **16** to the filament-forming material passing through the tube. The arm **6** with the tube attached thereto is mounted with an end of the arm held pivotably between two spaced brackets or extensions **33, 34** which extend from the top of the housing **14** and the wall **19** by two bolts **32** and **35**. The bolt **32** is hollow to render it fluid conductive. The filament-forming material is supplied to the apparatus through a tube **31** connected to the hollow bolt **32** which extends through the bracket **33** in threaded relationship therewith. The other bolt **35** is aligned coaxially with the bolt **32** and extends through the bracket **34** in threaded relation therewith. The arm **6** has coaxial recesses in which the ends of the bolts seat. The arm **6** is bored axially and radially to provide a passageway extending between the hollow bolt and the tube **27**. This type of pivotal joint is one well known in the art.

The housing **14** has an upwardly-extending annular neck **36** adapted to receive a tube **37**. The neck **36** may be counterbored as shown to provide a diameter complementary to the outer surface of the tube **37** and to the outer surface of an externally threaded packing-gland nut **39** which may be screwed downwardly against a packing material **40** to prevent any leakage between the tube **37** and the housing **14**. The tube **37** extends upwardly through a grommet **41** into a compartment **44** which collects used coagulant discharged therein from the tube **37**. The yarn which is discharged along with the used coagulant passes onto a device **45** comprising elements **46** of rounded cross-section which strip the coagulant from the strand as it is drawn thereover. The elements drain the removed coagulant into the compartment **44**. The used coagulant may be further utilized to reclaim some of the heat stored therein by draining it into the compartment **16** through a tube **47**, whereupon it submerges the heat exchanging coil **27** and then overflows through the apertures **23** of the wall **22**.

The interior surface of the neck **36** is flared in a downward direction as it joins the main portion of the housing **14** to provide a flow path of desirable contour surrounding a spinneret **5** for the liquid coagulant which flows upwardly through the housing during normal operation. The coagulant is supplied to the apparatus from a tube **51** connected to the housing by a bell-shaped adaptor **52**. To avoid local high velocity currents of the coagulant within the compartment **15**, the housing **14** has a floor portion **53** provided with a plurality of apertures **54** which cause the coagulant supplied to the apparatus to enter and flow through the chamber at a uniform velocity.

The flared surface of the neck is preferably contiguous with the lateral internal surface of the housing so as to provide a region within the housing in which coagulant may flow continuously upward from the floor portion **53** without flowing into pockets or trapped regions such as are obtained, for example, when a bell-mouthed tube protrudes downward below the ceiling of the spinning chamber. It is important in operation of the present invention to avoid the presence of any edges or protrusions internally of the spinning chamber around which the coagulant has to flow so as to avoid the attachment thereto of tacky partly coagulated material. It is also important in the operation of the present invention to prevent the entrapment or catching of any particles or masses of the strand-forming material because of the danger of such particles or masses working loose from the point of entrapment during normal operation and then becoming attached to the material being extruded from the spinneret and then passed along with the green strand to a strand guide whereupon the strand may break when such enlarged masses or strand portions pulled through the guide.

In starting the operation of the spinning apparatus of Figs. 1 and 2, the arm **6** in the spinneret will be normally positioned in some position disposing a spinneret above the level **55** of the bath in the chamber **16**. As the tubes **37** and **47** are shown broken, it will be readily understood that the normal position of the container **44** is above the region swept by the arm **6** and the tube **27** and that the arm and the tube may occupy a position above the housing **14** without interference with the container **44**. As a preferred lacing procedure, the flow of the filament-forming liquid through the spinneret will be commenced before the spinneret is lowered into the bath of compartment **16**. Therefore, assuming that the chamber **16** is filled with coagulant, coagulation of the material discharged from the spinneret will have commenced during movement of the spinneret from its non-operative position to the position shown in full line in Fig. 1. This means that a strand end of several inches in length has already been formed and is contiguous with the material being discharged from the spinneret as the arm swings into the position shown. Normally, the coagulated strand end, now buoyantly suspended in the coagulant within the chamber **16**, will be prevented from entering the chamber **15** by the outflowing of coagulant through the opening through which the spinneret enters the chamber **15**. The flow of the coagulant into the chamber **15** has been previously started before attempting to move the spinneret into its operating position.

As the coagulated material is buoyant within the coagulant, the coagulated strand end will normally extend over the upper part of the periphery of the opening as the closure **8** swings into place and is either cut by engagement of the resilient ring **10** with the periphery of the opening or is held fast when severance does not occur. Considering now a portion of the coagulated strand which has been caught at the periphery of the opening and extends upwardly through the chamber **15** into the tube **37** and is then looped downwardly toward the face of the spinneret wherefrom filament-forming material is now being constantly discharged, the swift current of the coagulant passing through the flared portion of the neck **36** into the tube quickly catches the loop portion and severs it close to the face of the spinneret. This, however, leaves a length of strand extending and dangling from a portion of the periphery of the opening up through the spinning chamber and perhaps into a portion of the tube **37**. It is important to free this dangling piece of strand so that it may leave the spinning chamber and the tube and does not later, after the spinning apparatus has been completely laced, come loose and promptly attach itself to the fresh yarn now continuously passing from the spinneret, and thus cause the breaking of the yarn as it is drawn through equipment disposed further along the path of the yarn.

To break loose any strand portion that may be caught between the closure **8** and the opening therefor, means such as the jet device **56** illustrated in Fig. 3 may be provided for ejecting a plurality of fine jets of liquid or gas, such as air toward the surface of the closure **8** which protrudes through the opening. The jet device **56** has a tube **57** extending through the wall **19** and upwardly to a valve **58** which may be attached for convenience of operation to the tube **47**. A high pressure fluid, preferably water, air, or the coagulant solution, is supplied through a supply tube **57*a*** connected with the tube **57**. The valve is preferably a type that may be operated instantly, as by a push-button, so that the pressure may be applied instantaneously to the jet device **56** to loosen a strand fragment caught within the chamber **15**. The valve **58** may be operated at

or slightly after the instant at which the arm is thrown into the position shown to promptly remove any strand fragment and thus allow an operator to proceed instantly with the lacing of the portions of a yarn manufacturing system related to the apparatus herein shown. Obviously other mechanical systems may be devised for the removal of yarn fragments in place of jet device **56** of which one is hereinafter described.

Fig. 4 illustrates by an elevation, partly in section, spinning apparatus having a number of the same principles of construction and operation as the previously described embodiment. However, in the apparatus of Fig. 4, a compartment **65**, analogous to compartment **16** of Fig. 1, is not used for preheating the strand-forming material prior to extrusion. Furthermore, the viscose or other filament-forming solution is conducted between the hub portion **66***a* and the closure portion **66***b* of the spinneret-supporting arm **66** by a simply curved tube **68** instead of the coiled rounder **27** of Fig. 1. The compartment **65** is filled only temporarily during the lacing of the apparatus. The spinning chamber **70** is supplied with a liquid for hardening the strand-forming material extruded from the spinneret **71** from a supply duct **72**. When the arm **66** is swung into the position shown in dotted outline wherein the spinneret is disposed well above the surface of the liquid at **73**, the hardening liquid or coagulant flows into the chamber **65** at a rate greater than can escape through a relatively small hole **75** extending through the wall **76**. Consequently, the liquid level is rapidly elevated to **73** at which the liquid may overflow through apertures **77** of the wall **76** into the passageway **78** and thereafter pass into a duct **79**. The chamber quickly empties by discharging through the aperture **75** after the arm **66** is swung into the position shown in full line in Fig. 4 thereby stopping any further flow of liquid from the chamber **70** into the chamber **65**.

For removing a strand fragment which may be caught between the closure **66***b* and the opening therefor through the common lateral wall **80** of the chambers **65** and **70**, a slide **81** extends through a wall **82** of the chamber **70** and is supported within the bearing **83** which comprises preferably, and at least in part, a resilient material fitting tightly around the outer periphery of the slide to provide a seal. The slide carries a blade **84** which may move into engagement with a strand fragment in the directions indicated by the double-headed arrow **85**. A finger-grip **86** is mounted on the slide exteriorly of the housing defining the compartment **70** whereby the operator may remove a strand fragment from the vicinity of the upper portion of the periphery of the opening of the wall **80** by moving the slide lengthwise of itself to sweep the blade across the inner face of the closure.

While preferred embodiments of the invention have been shown and described, it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined in the appended claims.

We claim:

1. Spinning apparatus comprising a spinning chamber, a duct extending upwardly from the interior of the chamber, an open-top chamber disposed laterally adjacent the first chamber, a wall between the two chambers having an opening therethrough connecting the interior regions of the chambers, means for controlling the passage of liquid from the open-top chamber to maintain the level thereof generally above said opening, a spinneret, means for movably supporting the spinneret, said supporting means being movable with respect to the chambers to transfer the spinneret from a position above said level to a position below said level within the spinning chamber wherein the spinneret faces into the duct, a closure fixedly associated with the spinneret for closing the opening at the latter-named position of the spinneret, and a second duct connected with the spinning chamber for supplying a liquid coagulant interiorly of said chamber, said means for controlling the liquid level of the open-top chamber being operative when the closure is removed from the opening and liquid coagulant is flowing therethrough into the open-top chamber from the first chamber.

2. Spinning apparatus comprising a spinning chamber, a duct extending upwardly from the interior of the chamber, an open-top chamber having a lateral wall in common with the spinning chamber, the wall having an opening therethrough connecting the interior regions of the chambers, overflow means for the open-top chamber disposed at a level generally above said opening for controlling the storage of liquid to a desired level, a spinneret, means for movably supporting the spinneret, said supporting means being movable with respect to the chambers to transfer the spinneret from a position above said level to a position below said level within the spinning chamber wherein the spinneret faces into the duct, a closure fixedly associated with the spinneret for closing the opening at the latter-named position of the spinneret, and a duct connected to the spinning chamber for supplying a liquid for hardening the extruded material into a filamentary strand interiorly of said chamber.

3. Spinning apparatus comprising a spinning chamber, a duct extending upwardly from the interior of the chamber, an open-top chamber having a lateral wall in common with the spinning chamber, the wall having an opening therethrough connecting the interior regions of the chambers, a wall of the open-top chamber other than the first wall having one or more openings extending therethrough above the first-named opening for controlling the storage of liquid therein to a desired level above said opening, a spinneret, pivotable means for supporting the spinneret, the pivotal axis of said means being spaced above the first named opening and in substantially parallel relation to the general plane of said opening whereby the spinneret may be positioned above said level and the interior region of the open-top chamber and swung to a position at a lower level within the spinning chamber wherein the spinneret is aligned to discharge a continuous extruded product through the duct, a closure fixedly associated with the spinneret for closing the first-named opening at the latter-named position of the spinneret, and a duct connected to the spinning chamber for supplying a liquid for hardening the extruded material into a filamentary strand.

4. Spinning apparatus comprising a spinning chamber, a duct extending upwardly from the interior of the chamber, the upper interior surface of the chamber extending inwardly and upwardly toward the lower mouth of the duct to define a bell-shaped entrance to the duct, an open top chamber having a lateral wall in common with the spinning chamber, said wall having an opening therethrough connecting the interior regions of the chambers, a wall of the open-top chamber other than the first-named wall having one or more openings extending therethrough above the level of the first-named opening for controlling the storage of liquid to a desired level above said opening, a spinneret, means for movably supporting the spinneret, said means being relatively movable with respect to the chambers to transfer the spinneret from a position above said level to a position below said level within the spinning chamber wherein the spinneret faces into the duct, a closure fixedly associated with the spinneret for closing the first-named opening at the latter-named position of the spinneret, and a duct connected to the spinning chamber for supplying a liquid for hardening the extruded material into a filamentary strand interiorly of the said chamber, means for severing a strand fragment held between the closure and the periphery of the first-named opening while the fragment is suspended within a liquid filling the spinning chamber, said means being movable within a region closely adjacent the inner surface of the closure, and means mounted exteriorly of the chambers for controlling the movement of the first-named means medium.

5. Apparatus as defined in claim 4 comprising a hollow fluid distributor mounted adjacent the common wall, the distributor having an aperture aligned for directing a stream of fluid transversely of the opening, duct means extending from the distributor through a wall of the first chamber for supplying the fluid at high pressure within said distributor and producing said stream as the means for engaging the strand fragment and a valve for controlling the passage of the fluid through the duct means.

6. Apparatus as defined in claim 4 comprising a movable element as said means for severing a strand fragment, means for movably supporting the element along an ambit through which the element sweeps a region within the spinning chamber immediately adjacent surfaces of the common wall and the closure along the periphery of the first-named opening, said movable means having a portion extending through a wall of the spinning chamber adapted to be manipulated exteriorly of said chamber.

7. Apparatus as defined in claim 4 comprising a blade elongate member of uniform cross section for supporting the blade, a bearing mounted on one wall of the spinning chamber for supporting a portion of said member interiorly of the spinning chamber and another portion exteriorly thereof, the bearing being disposed with respect to the first-named opening to provide movement of the blade within the spinning chamber in a direction substantially parallel to the general plane of said opening adjacent portions of the inner surface of the closure and the common wall which are adjacent a substantial portion of the periphery of said opening.

8. Spinning apparatus comprising a spinning chamber, a duct extending upwardly from the interior of the chamber, an open-top chamber having a lateral wall in common with the spinning chamber, the wall having an opening therethrough connecting the interior regions of the chambers, a wall of the open-top chamber other than the common wall having one or more overflow apertures therethrough for controlling storage of liquid therein to the desired level above the opening, a spinneret, a pivotable arm for supporting the spinneret, the pivot axis of the arm being disposed in upwardly spaced relation with respect to the opening and substantially parallel relation to the general plane of the opening whereby the spinneret may be positioned above said level and swung from said position to a position at a lower level within the spinning chamber with the face of the spinneret facing into the duct, the arm comprising a closure for the opening and an extension projecting interiorly of the spinning chamber, said extension supporting the spinneret in the latter-named position when the closure is positioned in, and closing, the opening, and a duct connected to the first chamber for supplying a liquid thereto.

9. Spinning apparatus comprising a spinning chamber, a duct extending upwardly from the interior of the chamber, an open-top chamber having a lateral wall in common with the first chamber, the wall having an opening therethrough connecting the interior regions of the chambers, a wall of the open-top chamber other than the first wall having an overflow passageway extending at

a level above the opening for maintaining liquid in the open-top chamber at a desired level above the opening, a spinneret, a pivotable arm for supporting the spinneret, the pivotal axis of the arm being spaced above to the opening and in substantially parallel relation to the general plane of the opening whereby the spinneret may be positioned above said level and swung to a position at a lower level within the spinning chamber wherein the spinneret faces upwardly into the lower opening of the duct, the arm comprising a closure positioned within, and closing, the opening in the latter position of the spinneret, a duct connected to the spinning chamber for supplying a liquid for coagulating filament-forming material into a strand, the arm having conduit means for conducting the strand-forming liquid to the spinneret comprising a coiled heat-exchanger duct supported by the arm substantially below said level at the position of the arm corresponding to the latter-named position of the spinneret within the spinning chamber, one end of the coiled duct being connected with the spinneret by a passageway extending through a portion of said arm, said first-named duct extending upwardly and terminating within a container disposed at a predetermined distance above the spinning chamber, and a drainage duct extending from the container into the open-top chamber.

10. Spinning apparatus comprising a spinning chamber, a duct extending upwardly from the interior of the chamber, an open-top chamber having a lateral wall in common with the spinning chamber, the wall having an opening therethrough connecting the interior regions of the chambers, a supply duct connected to the spinning chamber for conducting a liquid filament-hardening material thereinto, a wall of the open-top chamber other than the first wall having an overflow passageway disposed at a level above said opening and an aperture extending through the second wall at a level below said opening, said aperture having a liquid transfer rate substantially less than the rate of liquid transfer through said supply duct, a spinneret and pivotable means for supporting the spinneret, the pivotal axis of said supporting means being spaced above to the opening and in substantially parallel relation to the general plane of the opening whereby the spinneret may be positioned above the region of the open-top chamber that extends below said level and swung through the opening to a position at a lower level within the spinning chamber wherein the spinneret faces upwardly into the first duct, the pivotable means comprising a closure disposed within, and closing, the opening at the latter-named position of the spinneret, said overflow passageway being disposed above the spinneret in its latter-named position.

References Cited in the file of this patent

UNITED STATES PATENTS

827,434	Friedrich	July 31, 1906
1,641,588	Holken	Sept. 6, 1927
2,536,092	Roberts	Jan. 2, 1951
2,611,925	Merion et al.	Sept. 30, 1952