Jan. 12, 1971 H. RUCK ET AL 3,553,774

SPINNING HEAD FOR SPINNING BICOMPONENT FILAMENTS

Filed Aug. 23, 1968

3 Sheets-Sheet 1

FIG. 1

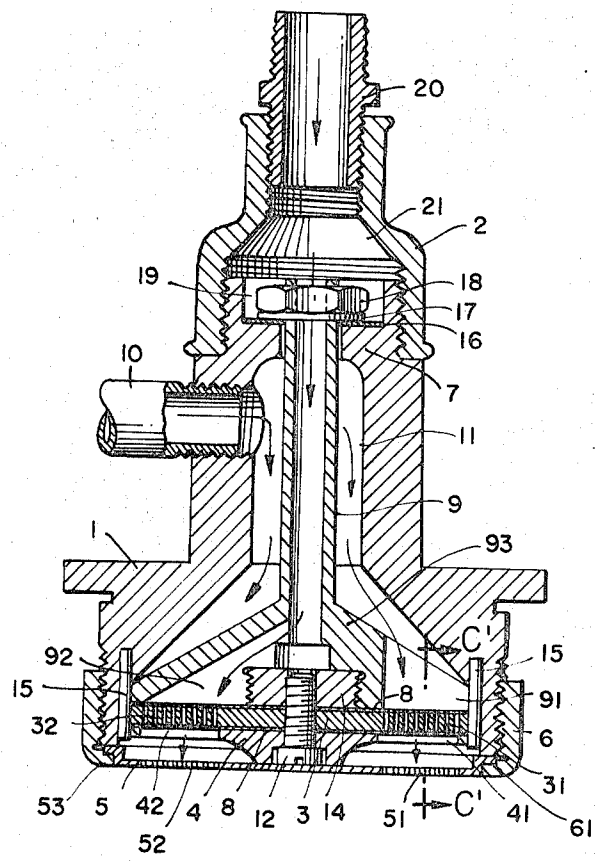

FIG. 2

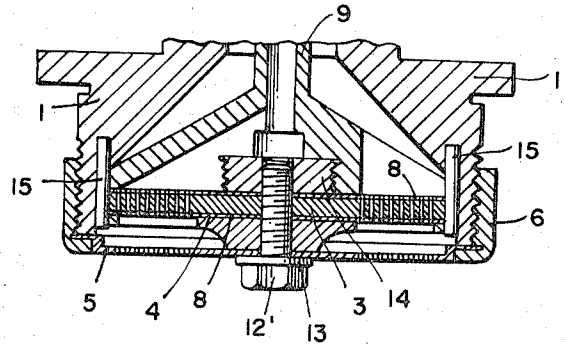

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FIG. 3

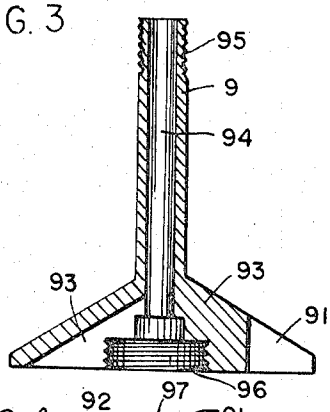

FIG. 4

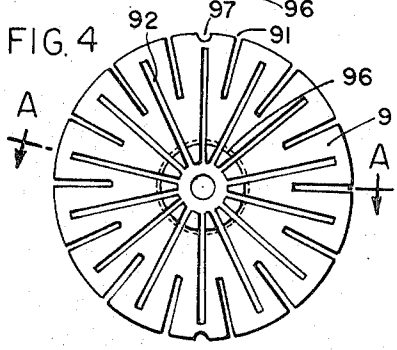

FIG. 5

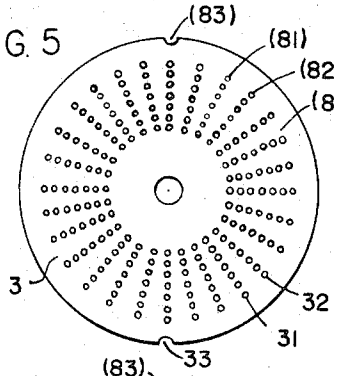

FIG. 6

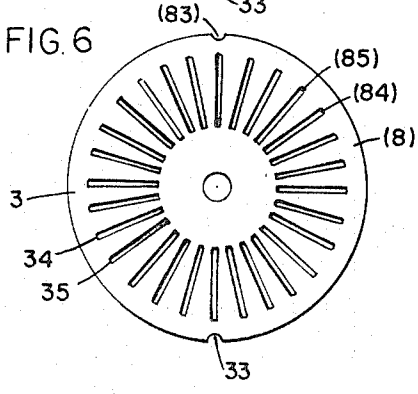

FIG. 7

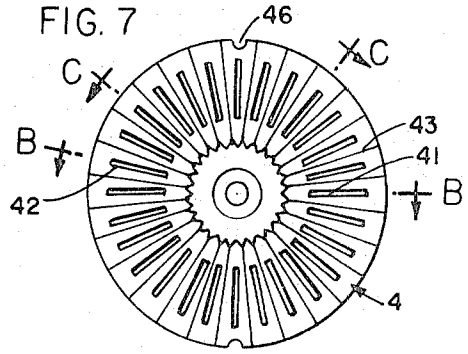

FIG. 8

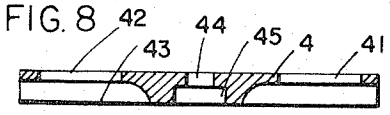

FIG. 9

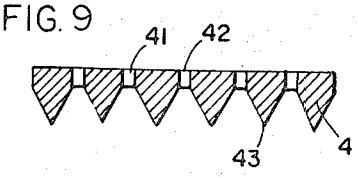

FIG. 10

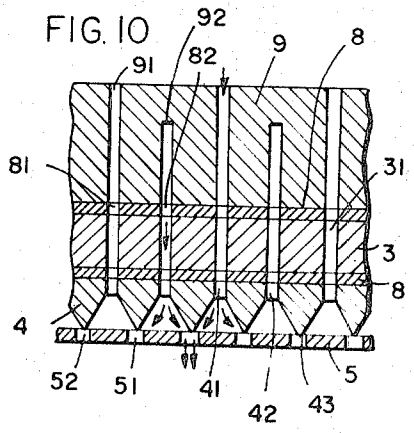

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FIG. 11

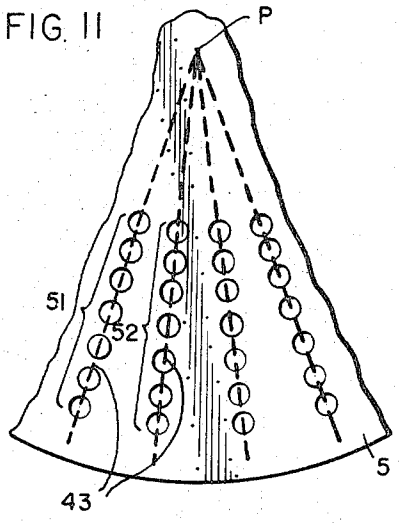


FIG. 12

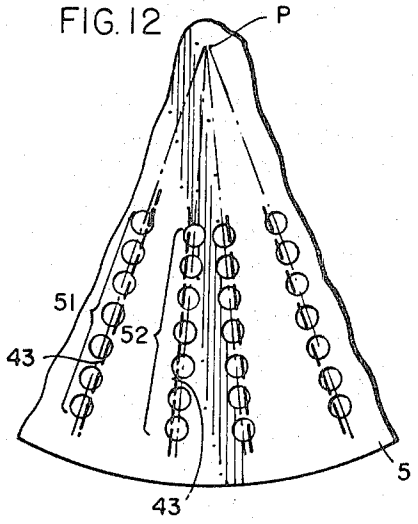


FIG. 13

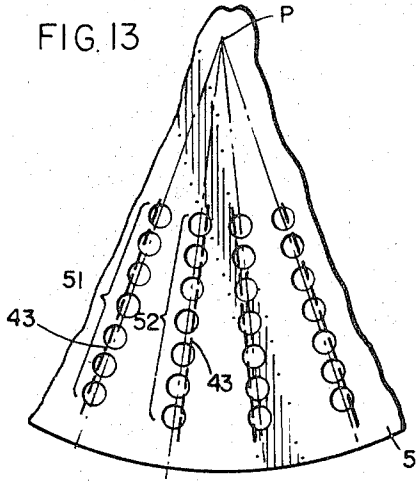


FIG. 14

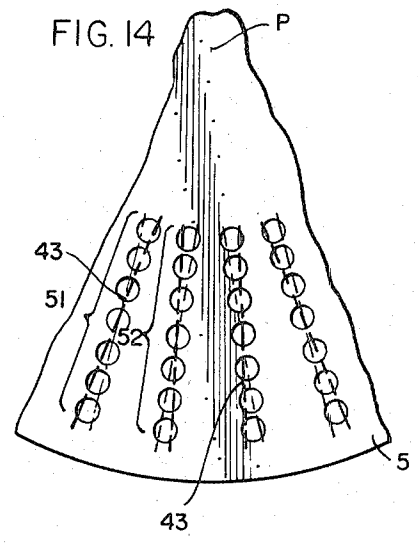
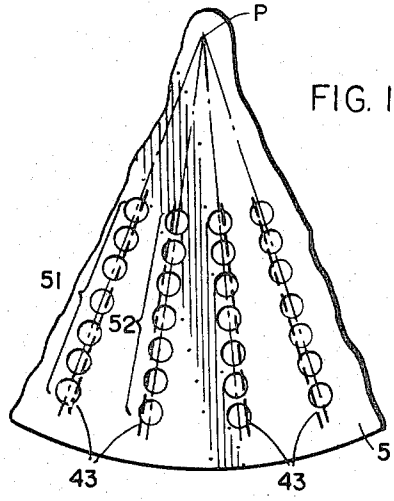


FIG. 15



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3,553,774

SPINNING HEAD FOR SPINNING BICOMPONENT FILAMENTS

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Claims priority, application Germany, Aug. 25, 1967, 1,660,236
Int. Cl. D01d
U.S. Cl. 18—8 15 Claims

ABSTRACT OF THE DISCLOSURE

An improved construction in the distribution system of a spinning head for producing bicomponent filaments from two distinct fluid spinning compositions brought together for extrusion on either side of a thin knife edge intersecting each spinning opening of a multi-holed nozzle plate mounted on the face of the spinning head. The elements of the distribution system essentially include a slotted distributor plate with separate radial channels and a conically-shaped insert having alternate inner and outer radial slots in fluid connection with separate feed means on the inlet side and with the radial channels of the distributor plate on the outlet side.

In general, this invention relates to a spinning head having a nozzle plate on the face or lower end thereof containing a large number of spinning openings, bores or orifices and so designed as to permit the simultaneous spinning of a correspondingly large number of bicomponent filaments from two distinct fluid spinning compositions. In such spinning heads, it is necessary to conduct the different spinning solutions or fluid compositions separately through the spinning head up to a point immediately before the plane of the nozzle plate, the separately flowing streams then being united over a knife edge or similar wedge-shaped blade or projections so as to be extruded side by side in common through the spinning openings of the nozzle plate.

Several devices for the spinning of bicomponent filaments or threads have been described in the prior art. For example, U.S. Pat. No. 3,176,342 discloses a spinning head containing concentric annular chambers which are separated or subdivided by concentric annular walls tapering to knife-like edges at their outer ends and arranged directly over the nozzle plate. The nozzle plate itself is constructed with a plurality of concentric V-shaped corrugations or ridges which are engaged along their apexes by the knife-edged walls, these apexes also containing a plurality of spinning openings or orifices. This particular construction permits only a relatively poor utilization of the cross-sectional space of the spinning head, this so-called "degree of utilization" being defined herein as the number of spinning openings or orifices per square millimeter of the effective nozzle plate surface. In turn, this "effective nozzle plate surface" is defined herein as the surface which is enclosed by the outermost spinning openings of the nozzle plate. A further disadvantage of the type of spinning head described in U.S. Pat. No. 3,176,342 is the absence of any possibility of installing suitable means for pressure equalization on the spinning solutions being fed to individual spinning openings. As a result, the filaments differ considerably in their composition and their speed of extrusion, depending upon the exact position of the spinning openings through which they have been spun in relation to the feed line. Thus, in the absence of some pressure equalization or balancing element in the apparatus, the resulting

filaments tend to be nonuniform and lead to disadvantageous effects in their further processing.

Another known spinning device, as disclosed in German Pat. No. 956,714, also provides concentric annular spaces or else parallel, horizontally arranged channels for the separate conduction of the two different spinning solutions to the spinning openings in the nozzle plate. A certain amount of pressure balancing is achieved by distributor elements in this device, but the above-defined "degree of utilization" is again very small due to the manner in which the spinning head is constructed. Furthermore, the filaments spun with this device have more of the appearance of so-called core-mantle filaments with their cross-sectional composition varying or changing in the linear direction of the filament.

Still another device is described in British Pat. No. 996,415 wherein the nozzle member of the spinning head forms a distributor system by means of horizontal and vertical bores of various diameters, this distributor system exhibiting V-grooves underneath in which there are fitted corresponding V-shaped grooves of the nozzle plate. The nozzle plate itself has Y-shaped spinning openings. This particular spinning head permits the spinning or extrusion of a bicomponent filament with relatively constant composition, but the two components do not lie side by side in the cross-section of the filament and the position of the two components with respect to each other in this cross-section does not remain constant but varies in the linear direction of the filament and also varies from filament to filament. In addition to the fact that this spinning head is quite expensive to manufacture, it also has the disadvantage that it is extremely difficult to clean. Again, the above-defined "degree of utilization" is quite low.

Finally, German Pat. No. 970,603 describes a device for the spinning of multicomponent threads (side-by-side threads), in which the nozzle plate contains radially, parallel or concentrically arranged rows of holes or openings. Above the nozzle plate and at a short distance therefrom, there are situated multi-angled chambers with walls standing at an angle to one another, these walls being shaped as a knife-edge or separating blade at their lower ends. This spinning device is quite well suited for the spinning in common of three or more components, but because of its low degree of utilization, it does not prevent a satisfactory solution to the problem of economically spinning bicomponent threads. Furthermore, the particular design of this spinning head provides many dead spaces in the flow of the spinning composition, so that depending upon the particular selection of a spinning solution, spinning melt or the like, the device clogs up or becomes plugged relatively frequently and can then be cleaned only with great difficulty.

One object of the present invention is to provide an improved spinning head for the production of synthetic bicomponent filaments by means of a nozzle plate and distributor construction and arrangement which provides a high degree of utilization, i.e. whereby a large number of bicomponent filaments can be spun from a single spinning unit. Another object of the invention is to provide an improved spinning head for the production of bicomponent filaments wherein the construction and arrangement of parts presents as few dead flow spaces as possible so as to prevent clogging, while at the same time providing a spinning head which can be easily disassembled for cleaning and then reassembled in an accurate manner. Yet another object of the invention is to provide a spinning head in which the fluid streams of the spinning compositions can be directed in a favorable manner from the viewpoint of flow technology, while guaranteeing a uniform composition of all of the bicomponent filaments issuing from

the nozzle plate, such uniformity being achieved both longitudinally and cross-sectionally as well as from filament to filament. Furthermore, it is an object of the invention to provide a nozzle plate and distributor assembly in a spinning head which permits a number of variations in the properties and appearances of the spun bicomponent filaments and yarns obtained from a single spinning unit.

Other objects and advantages of the invention will become more apparent upon consideration of the following detailed specification.

In accordance with the invention, there is provided an improved device or combination of apparatus for the distribution of the two spinning compositions to the spinning openings or orifices of a nozzle plate where the fluid spinning compositions are extruded side-by-side through each individual spinning orifice to form the bicomponent filament. In essence, the improved spinning device of the invention includes: a spinning head in the form of a hollow, substantially cylindrical housing; a circular nozzle plate held in place on the front face of said spinning head; a circular distributor plate superimposed behind the nozzle plate within the housing and having radially extending channels formed by side walls extending forwardly to intersect the spinning openings contained in the nozzle plate; a conically-shaped insert with its base superimposed behind the distributor plate within said housing and having inner and outer radial slots aligned with corresponding slots extending through the distributor plate into the radial channels thereof, the outer slots extending through the outer circumference of the conically-shaped insert to connect with an outer feed space in the housing and the inner slots extending inwardly from a central annular area of the base of said insert to connect with an inner feed space along the axis of the housing; and annular partition means in said housing separating the inner feed space from the outer feed space, these means including the conically tapered rear wall structure of the insert.

The invention may also be defined in combination with a conventional spinning head with its nozzle plate containing a plurality of spinning openings as an improvement for the distribution of each of the two spinning compositions to the spinning openings comprising:

(1) A distributor plate arranged within said spinning head immediately behind said nozzle plate and having a plurality of radially extending channels separated from one another by forwardly extending projections, each of which terminates in a thin line edge in contacting relationship with the rear face of said nozzle plate so as to intersect correspondingly positioned series of spinning openings in the nozzle plate, said distributor plate containing radial slots in fluid communication with each of said channels; (2) a radially narrowing substantially conical insert arranged within said spinning head with its base facing said distributor plate and containing a plurality of radially positioned alternate outer and inner slotted channels superimposed behind and in fluid connection with said distributor plate slots, said outer slotted channels extending axially through said insert around an outer circumferential portion thereof in fluid connection at their rearward ends with an annular outer feed space extending around and behind said insert in said spinning head and said inner slotted channels extending rearwardly from the base and within said insert to an axially positioned inner feed space which projects rearwardly of said insert into a fluid conduit positioned within said annular outer feed space; (3) means to introduce one fluid spinning composition into said annular outer feed space; and (4) means to introduce a second fluid spinning composition into said axial inner feed space.

When using relatively high viscosity spinning solutions or fluid compositions, it is particularly desirable to insert a pressure balancing plate between the distributor plate and the base of the conical insert, this pressure balancing plate containing a plurality of radially positioned openings interconnecting the radial slots of the distributor plate and the radial slots of the insert. Also, while it is possible to obtain a good sealing contact between each of the plates in the distribution system with each other or with the base of the conical insert by careful grinding to achieve flat superimposed surfaces of these elements, it is particularly advantageous from an economic and manufacturing viewpoint to provide one or more gaskets capable of being inserted between these elements and having radially positioned openings coinciding with the radial slots of the distributor plate and the conically-shaped insert.

While the nozzle plate may be supported in a conventional manner around its periphery to the spinning head, for example by suitable clamping or capping means, it is especially desirable when working under high spinning pressures to further support the nozzle plate at the center thereof, for example by bolting means which preferably interconnect the nozzle plate with the distributor plate and with the conical insert to the spinning head. This not only avoids any possible sagging of the nozzle plate, but there is likewise achieved a positive sealing of the radial channels or chambers situated below the slots of the distributor plate, i.e. where the forwardly extending projections or walls terminate in a thin line edge in contact with the nozzle plate.

Since the projections or walls of the distributor plate which interesect the nozzle plate openings must be very accurately positioned, it is advantageous for the spinning head to carry guide means on which the distributor plate and the conical insert, as well as any pressure balancing plate, can be carefully aligned so as to permit not only the proper position of the thin line edges on the nozzle plate openings but also to make certain that the interconnected slots and channels of the various elements of the distributor system are aligned in relationship to each other. Any suitable guide pins can be used for this purpose or else the inner circumferential surface of the housing corresponding to the spinning head may contain elongated keys or wedges at spaced circumferential positions and designed to fit into correspondingly profiled notches or recesses around the circumference of the distributor plate, pressure balancing plate and conical insert. Intermediate gaskets sealing these members can likewise be profiled in the same manner.

The combination of spinning apparatus according to the invention is particularly well adapted for the production of a very large number of bicomponent filaments wherein a specific ratio or proportion of each of the components can be established and maintained over the cross-section of each individual filament. Furthermore, as explained in greater detail below, special constructions and arrangements of the distributor plate and/or of the nozzle plate permit special effects to be achieved in the spinning of the bicomponent filaments.

The invention can be more readily understood by referring to the accompanying drawing wherein similar parts are identified by similar reference numerals and wherein:

FIG. 1 is a cross-sectional view taken on the longitudinal axis of a spinning head constructed in accordance with the invention;

FIG. 2 is a partial cross-sectional view taken on the longitudinal axis of another embodiment of the spinning head according to the invention, illustrating additional supporting means for the nozzle plate;

FIG. 3 is a partial cross-sectional view taken on line A—A of FIG. 4 and illustrating only the conical insert and its integral feed conduit;

FIG. 4 is a bottom plan view of the conical insert;

FIG. 5 is a bottom plan view of one embodiment of the pressure balancing plate and may also be taken as illustrating any one of the intermediate gaskets;

FIG. 6 is a bottom plan view of another embodiment

of the pressure balancing plate or the similarly constructed gaskets;

FIG. 7 is a bottom plan view of the distributor plate;

FIG. 8 is a sectional view taken on line B—B of the distributor plate as illustrated in FIG. 7;

FIG. 9 is a sectional view taken on line C—C of the distributor plate as shown in FIG. 7;

FIG. 10 is a sectional segment of the conical insert, pressure balancing plate, distributor plate and nozzle plate in their assembled state as taken on line C—C of FIG. 6 and line C'—C' in FIG. 1; and

FIGS. 11–15 are top plan views of a small segment of the nozzle plate illustrating various embodiments of the relationship between the thin line edges of the distributor plate and the spinning openings of the nozzle plate.

In some instances in the drawing, major elements of the distribution system are identified by a single reference numeral, for example the pressure balancing plate **3**, distributor plate **4**, nozzle plate **5**, and conical insert **9**. In subsequently identifying individual parts of each of such elements, the same first numeral is employed followed by a second numeral so as to facilitate the identification of the major element in each instance. Thus, as shown in FIG. 5, the pressure balancing plate **3** contains the rows of holes **31** and **32** as well as a recessed notch **33**. Also, since FIG. 5 may also represent the intermediate gaskets **8**, these also contain the rows of holes **81** and **82** as well as the recessed notches **83**. These latter numbers have been placed in parentheses in order to indicate that they are associated only with the gaskets and not the pressure balancing plate. This same means of indicating both a pressure balancing plate and a gasket is also used in FIG. 6.

The spinning head of the invention is most completely illustrated in the axial cross-section of FIG. 1 where it has been placed in a vertical position so that the nozzle plate is mounted on the lower end of the spinning head. It will be apparent, however, that the spinning head can be mounted in other positions, so that throughout this specification the end of the spinning head containing the nozzle plate has been designated as the forward end with various elements then being positioned behind the nozzle plate and the top end of the spinning head as shown in the drawing being considered as the rearward end. The spinning head **1** is preferably cylindrical in shape with a somewhat enlarged forward portion adapted to receive the nozzle plate and most of the elements of the distributor system. A feed conduit **10** is arranged radially or laterally of the rearward portion of the spinning head, so as to introduce one of the fluid spinning compositions into a first annular outer feed space **11** within the housing. A second feed conduit **20** is arranged axially of the spinning head to introduce a second spinning composition into the temporary feed space **21** formed in part by the coupling or socket joint **2**. It will be recognized that this socket joint **2** forms a threaded coupling with both the housing **1** and the feed conduit **20** thereby permitting these members to be readily disassembled. The arrows in FIG. 1 generally indicate the direction of flow of the two spinning compositions through the apparatus.

At the face end of the spinning head housing **1**, the nozzle plate **5** is securely fastened by clamping its peripheral collar or flange **53** with the screw cap **6** which can be threadably engaged on the outer circumferential surface of the housing **1**. The nozzle plate contains a large number of spinning openings or orifices arranged in individual rows **51** and **52**, various arrangements of these rows of openings being possible as indicated in FIGS. 11–15, although the rows of openings are preferably centered on or near radial lines extending outwardly from the center point P of the nozzle plate **5** toward its outer periphery.

Directly behind this nozzle plate **5** and fitting snugly into a cylindrically recessed portion of the housing **3**, there is mounted the distributor plate **4** containing a plurality of radially positioned slits or slots **41** and **42** and having a thin leading edge **43** projecting outwardly from the face thereof to rest in contact with the nozzle plate **5**, the ridges or thin knife-like edges **43** of the distributor plate projection **4** as shown in greater detail in FIG. 10 being positioned so as to intersect the rows of the nozzle plate openings **51** and **52**. These forwardly extending projections of the distributor plate **4** also define radially positioned channels between adjacent pairs of projections, the radial slots **41** and **42** of the distributor plate opening centrally into these radial channels to provide a flow of the spinning composition to a portion of the spinning openings falling within either side of the channel.

Directly behind the distributor plate **4** and within the housing **1**, there is preferably mounted a pressure balancing plate **3** containing rows of holes **31** and **32** (FIG. 5) or a corresponding plurality of radial slots **34** and **35** (FIG. 6) which are held in alignment with the slots of the distributor plate **4**.

Then, behind this pressure balancing plate, there is arranged the conically-shaped insert **9** which contains a plurality of outer slots **91** extending through the cone-shaped element around its outer circumference from the flat base thereof to the rearwardly sloping or tapering surface. These radially positioned slots **91** alternate with inner radial slots **92** which are recessed in the base of the cone-shaped member **93** to provide a fluid communication with the rearwardly extending feed conduit or tube **94** which is formed integrally with the cone-shaped member **93**. These details are more clearly illustrated in FIGS. 3 and 4 which clearly disclose the radial position of the outer and inner slots **91** and **92** as well as their arrangement in an axial cross-section of the cone-shaped member **93**.

In order to achieve a tight sealing of the individual elements of the distributor system, one against the other, it is preferable to insert the gaskets **8** which are also provided with rows of openings **81** and **82** or slots **84** and **85** coinciding with the openings or slots of the adjacent distributor elements. Also, all of these elements can be tightened together by means of the socket head cap screw **12** inserted through the bore **44** and countersunk recess **45** of the distributor plate (see FIG. 8). This cap screw also extends through corresponding central bores of the pressure balancing plate **3** and the gaskets **8**, and is then screwed into the threaded cylindrical block **14** which in turn is threadably engaged at **96** with the conical insert **9**. In this manner, a positive pressurized seal is placed over all of the interconnected elements so that they can be retained firmly in position and avoid any possibility of leakage of the spinning compositions, particularly in the area where the leading edges **43** of the distributor plate **4** contact the nozzle plate **5**. The feed conduit **94** integral with the cone-shaped member **93** is threaded at its most rearward end **95** (FIG. 3) in order to receive the nut **18** mounted over washer **17** and gasket **16**, so that when nut **18** is tightened the washer and gasket engage inwardly projecting flanges or shoulders **7** of the housing **1** and draw the distributor assembly axially toward the rear of the spinning head. Thus, the entire distributor assembly is also firmly seated in the axial direction of the recessed spinning head **1**.

In order to disassemble the apparatus, the nozzle plate **5** can be readily removed by simply unscrewing the cap **6** and removing the nozzle plate. Access is then provided to the screw **12** which can be removed in order to disengage all of the elements of the distributor assembly other than the conically-shaped insert **9**. In order to remove this insert **9**, it is merely necessary to unscrew the spinning head **1** from the socket joint **2** in order to provide access to the nut **18** which has been tightened into the recess **19** on the spinning head inner shoulder or flange **7**. If desired, the recessed space **19** can be filled with a packing or covered with a gasket of an inert material in order to avoid a dead space capable of collecting the spinning composition.

The reassembly of the device is greatly facilitated by means of the guide pins **15** carried in the housing **1** of the spinning head. These guide pins **15** are placed to engage the recesses or notches diametrically opposed on the periphery of the various distributor elements, for example the notches **33** and **83** of the pressure balancing plate **3** or gasket **8** (FIGS. 5 and 6), the notches **97** of the conical insert **9** (FIG. 4) and the notches **46** of the distributor plate **4** (FIG. 7). By using these guide pins and a strong axial connection of all of the distributor elements, the various slots and/or openings in these elements can be maintained in perfect alignment over long periods of operation. On the other hand, the apparatus is very easily disassembled for purposes of cleaning.

FIG. 2 illustrates a slightly different embodiment of the spinning head which is particularly adapted to operate under high spinning pressures. In this case, not only are the distributor elements **4**, **8** and **3** bolted to the conical insert **9** through block **14**, but also the nozzle plate **5** is interconnected with these members by means of the hexagonal screw **12'** and the supporting washer **13**. Thus, the nozzle plate **5** is supported not only at its outer periphery by means of the flange or rim **53** on shoulder **61** of the screw cap **6**, but it is also supported centrally so that during spinning a sagging of the nozzle plate can be prevented and at the same time there is also achieved a further sealing of the radial channels of the distributor plate **4** formed by the leading edges **43**. At low spinning pressures, this precaution is not absolutely essential but does constitute a preferred construction in order to make absolutely certain that no spinning composition will leak from one radial channel to the next as it passes from the radial slots **41** and **42** to the individual spinning openings.

The path of flow of the two spinning solutions or fluid spinning compositions can be viewed with particular reference to FIGS. 1 and 10 where the flow path is indicated by arrows. The first spinning composition flows through the feed line **10** and passes into the annular feed space **11** which is preferably arranged concentrically around the inner feed conduit **94**. The spinning composition then flows forwardly in the spinning head **1** onto the conically tapering rear surfaces of the cone-shaped member **93**. As indicated in FIGS. 3 and 4, this cone **93** has outer slots **91** and inner slots **92** which alternate in the circumferential direction, the outer slots **91** being connected with the feed space **11** while being partitioned from the second spinning composition which enters through inlet **20**, through the temporary feed space and then into the enclosed axial feed space **94**. Thus, as the second spinning composition is introduced into the distributor system, it flows through the inner slots **92** which are separated by radial walls of the cone **93** from the outer slots **92**. This separation of the two flow streams is continued as the different spinning compositions pass downwardly through the coinciding openings or slots of the pressure balancing plate **3** and gaskets **8** as well as the slots **41** and **42** of the distributor plate **4**. Each spinning composition then flows outwardly in alternating sequence around the circumference of the distributor plate **4** through the radially positioned channels enclosed by the projecting edges **43**. Each of the two spinning compisitions is thus brought separately to each side of each row of openings or orifices in the spinning nozzle plate.

As particularly illustrated in FIGS. 7–10, the nozzle plate **5** has the same number of rows of openings **51** and **52** as those elements of the distributor assembly positioned directly behind the nozzle plate. These rows of openings in the nozzle plate, however, are staggered in relationship to the preceding slots or openings so as to fall directly in alignment with the leading edges **43** of the distributor plate **4**. In most of the embodiments shown in the drawing other than FIGS. 12–15, these rows of openings of the nozzle plate **5** are positioned on radial lines, each of which bisects the angle formed by the radial lines of two adjacent leading edges **43**. In this manner, the edges **43** bisect the cross-sections of the individual holes in each of the rows **51** and **52** as shown in specific detail in FIG. 11. The adjustment of the nozzle plate so that the edges **43** exactly bisect the openings **51** and **52**, e.g. as seen in FIGS. 10 and 11, can be accomplished by hand while carefully controlling the tightening of the cap screw **6**, but it is preferably accomplished by structural means such as the guide pins **15** which can extend forwardly from that shown in the drawing in order to engage notches in the nozzle plate similar to the notches or recesses **33**, **46**, **83** and **97** of the elements of the distributor assembly. (This particular means of aligning the nozzle plate is not represented in the drawing.)

As the two separate spinning compositions pass over the leading edges **43** of the distributor plate **4** as supplied separately from the slots **41** and **42**, they are joined together and pressed side by side in common through the spinning openings or orifices **51** and **52** of the nozzle plate **5**. Where the edges **43** bisect these openings **51** and **52**, it will be recognized that the individual components have approximately a 50:50 proportion of the cross-section of the extruded spun filament.

It should be apparent that the device of the invention can be modified in many different ways without departing from its essential features. In particular, a number of desirable modifications in the arrangement of the nozzle plate openings and the distributor plate leading edges are illustrated in FIGS. 11–15. FIG. 11, as noted above, illustrates that arrangement in which both the rows of openings **51** and **52** and the leading thin edges **43** fall on the same radial lines extending from the center point P on the axis of the spinning head outwardly to the periphery of the nozzle plate. In remaining FIGS. 12–15, the center lines of the rows of openings **51** and **52** are shown with a light broken line while the projection of the thin projecting adges **43** of the distributor plate **4** are indicated by the heavier broken lines.

As shown in FIG. 12, the thin line edge for each forwardly extending projection **43** of the distributor plate **4** extends radially, passing through point P, in order to secantially intersect a row of individual spinning openings **51** or **52** positioned on a secantial line of the nozzle plate parallel to the line of the thin edge **43**. In this manner, the proportion of the two spinning components can be varied in almost any ratio when viewing the filaments in cross section, while at the same time this ratio can be kept constant for all of the filaments being extruded by a single spinning head. This same result can be achieved by just the opposite arrangement as shown in FIG. 13, wherein the individual spinning openings in the nozzle plate are arranged in rows on radial lines **51** and **52** while the thin line edges **43** extend approximately from the center outwardly to secantially intersect the individual spinning openings on lines parallel to the radial lines of the rows of openings. In both cases, by offsetting the center lines of the openings from the parallel lines of the thin edges by only a few tenths of a millimeter, the proportionate amounts of the two different spinning compositions can be easily adjusted with only very slight alterations in the construction of the entire device. In general, it is desirable to adjust the rate at which the spinning compositions or solutions are supplied to the nozzle plate openings so that the speed or rate of supply of that component having the smaller cross-sectional area in the filament will be smaller than the rate of the component forming the larger cross-sectional area of the filament. In this manner, the rates of supply can be adjusted such that the two components emerge from the spinning opening with exactly the same velocity, thereby making certain that the spun filaments will have a high degree of uniformity.

On the other hand, if the feed or supply rates of the two different spinning solutions are varied in such a manner that the components flow through the nozzle

openings at a different speed, it is then possible to achieve various different crimping effects.

As shown in FIG. 14, it is further possible to arrange the rows of individual spinning openings **51** and **52** as well as the thin edges **43** on secantial lines, with reference to the circular nozzle plate **5** with center point P, such that the lines of the nozzle plate openings and the lines of the thin edges intersect each other at a small angle at a point intermediate the inner and outer ends of each row of openings. In this case, the spinning head is adapted to simultaneously extrude filaments, some of which have only one component while others have only the other component, and a relatively large number of filaments have varying amounts of both components. By using two differently colored spinning compositions, this arrangement leads to a yarn having an interesting melange effect. Finally, as shown in FIG. 15, it is possible by means of the construction and arrangement of the spinning head of the invention to produce a so-called "effect yarn" by adjusting the nozzle plate in such a way that the individual spinning openings in the nozzle plate are arranged in rows on radial lines of the nozzle plate and the thin line edges of the forwardly extending projections **43** follow radial lines offset by a small central angle from the radial lines of the rows of openings. The resulting spun filaments, depending upon their spinning position with reference to the center of the nozzle plate, then present different proportions of each component. This variation in proportions, particularly with differently colored spinning solutions or compositions leads to yarns having a very highly distinctive and interesting appearance.

Other modifications can also be made in the construction and arrangement of the apparatus according to the invention without departing from the spirit or scope thereof. For example, one can omit the packings **8** and instead carefully grind the surfaces of the preferably flat adjoining elements of the distributor system, e.g. elements **9**, **3** and **4**, so that they have a self-sealing effect. Also, since the conical insert **9** provides in itself a certain pressure-balancing action by means of the outer and inner slots **91** and **92**, it is often possible to dispense with the pressure-balancing plate **3** so that the spinning head becomes even simpler in its construction. For this same reason, the pressure-balancing plate **3** can contain a series of rows of bores or openings **31** or **32** as shown in FIG. 5 as well as slotted openings **34** and **35** as shown in FIG. 6. In either event, the apparatus does not lose any essential characteristic. In general, it is preferred to employ distributor elements having relatively broad slots, especially when using spinning solutions, melts or the like of high viscosity.

By using the distributor assembly in combination with a spinning head and nozzle plate in accordance with the invention, one achieves an optimum utilization of the nozzle plate surface, i.e. so as to produce a very large number of bicomponent filaments. This result is made possible essentially by the slots which extend substantially radially in each of the essential elements of the distributor assembly, i.e. the distributor plate itself and the conical insert. Thus, the alternating arrangement of outer and inner slots in the conical insert is especially favorable from the viewpoint of flow technology, because in the first place there can be no flow dead spaces occurring in the conical insert and, in the second place, the cross-sectional dimensions of these slots in the conical insert widen steadily from the inlet to the outlet side of the insert, such that there normally occurs a sufficient pressure balancing which is absolutely necessary in achieving homogeneous spun filaments of high quality. The pressure balancing plate can obviously be added or even made an integral part of the conical insert or the distributor plate, thereby further enhancing the proper pressure balancing when working with highly viscous spinning compositions. However, many variations can be accepted in this pressure balancing plate so that it has become apparent that the conical insert together with the distributing plate represent the most critical features of the present invention. When working with these critical elements and within the specified limitations of the invention, one can achieve a very substantial improvement in the spinning of bicomponent filaments, both in terms of a very economical operation as well as the production of highly uniform bicomponent filaments with reference to either individual filaments or the entire bundle of filaments producing a yarn from the spinning head.

The invention is hereby claimed as follows:

1. In combination with a spinning head for the simultaneous production of a plurality of bicomponent filaments from two distinct fluid spinning compositions extruded side by side through a plurality of spinning openings in a nozzle plate mounted on the face of said spinning head, the improvement for distribution of each spinning composition to said spinning openings which comprises:

a distributor plate arranged within said spinning head immediately behind said nozzle plate and having a plurality of radially extending channels separated from one another by forwardly extending projections, each of which terminates in a thin line edge in contacting relationship with the rear face of said nozzle plate so as to intersect correspondingly positioned series of spinning openings in the nozzle plate, said distributor plate containing radial slots in fluid communication with each of said channels;

a radially narrowing substantially conical insert arranged within said spinning head with its base facing said distributor plate and containing a plurality of radially positioned alternate outer and inner slotted channels superimposed behind and in fluid connection with said distributor plate slots, said outer slotted channels extending axially through said insert around an outer circumferential portion thereof in fluid connection at their rearward ends with an annular outer feed space extending around and behind said insert in said spinning head and said inner slotted channels extending rearwardly from the base and within said insert to an axially positioned inner feed space which projects rearwardly of said insert into a fluid conduit positioned within said annular outer feed space;

means to introduce one fluid spinning composition into said annular outer feed space; and

means to introduce a second fluid spinning composition into said axial inner feed space.

2. The improved combination as defined in claim **1** wherein a pressure balancing plate is mounted between said distributor plate and the base of said conical insert said pressure balancing plate containing a plurality of radially positioned openings interconnecting the radial slots of said distributor plate and the radial slots of said insert.

3. The improved combination as defined in claim **2** wherein said openings in said pressure balancing plate are radial slots coinciding with the radial slots of said distributor plate and said insert.

4. The improved combination as defined in claim **2** wherein said openings in said pressure balancing plate are radially positioned rows of individual bores superimposed between the radial slots of said distributor plate and said insert.

5. The improved combination as defined in claim **1** wherein the fluid connection between said distributor plate and said conical insert is sealed by at least one gasket having radially positioned openings coinciding with the radial slots of said distributor plate and said insert.

6. The improved combination as defined in claim **2** wherein the fluid connection between said pressure balancing plate and the distributor plate on one side and the base of the conical insert on the other side is sealed in each instance by a gasket having radial openings in alignment with the openings of said pressure balancing plate

and the slots of said distributor plate and said conical insert.

7. The improved combination as defined in claim 1 wherein said nozzle plate is supportingly mounted around its periphery to said spinning head and is further supported at the center thereof by bolting means interconnecting said nozzle plate with said distributor plate and said conical insert to said spinning head.

8. The improved combination as defined in claim 1 wherein said spinning head carries guide means to accurately position said distributor plate and said conical insert for alignment of their interconnected slots and channels in relationship to the spinning openings in said nozzle plate.

9. The improved combination as defined in claim 1 wherein the thin line edge of each forwardly extending projection of said distributor plate extends radially to bisect a correspondingly radially positioned row of individual spinning openings.

10. The improved combination as defined in claim 1 wherein the thin line edge of each forwardly extending projection of said distributor plate extends radially to secantially intersect a row of individual spinning openings positioned on a secantial line of the nozzle plate parallel to said edge.

11. The improved combination as defined in claim 1 wherein the individual spinning openings in said nozzle plate are arranged in rows on radial lines thereof and said thin line edges of said forwardly extending projections of said distributor plate extend from the center outwardly to secantially intersect the individual spinning openings on lines parallel to the radial lines of said rows of openings.

12. The improved combination as defined in claim 1 wherein the individual spinning openings in said nozzle plate are arranged in rows on lines which intersect at a small angle with the thin line edges at a point intermediate the inner and outer ends of each row.

13. The improved combination as defined in claim 1 wherein the individual spinning openings in said nozzle plate are arranged in rows on radial lines thereof and said thin line edges of said forwardly extending projections follow radial lines offset by a small central angle from the radial lines of said rows of openings.

14. The improved combination as defined in claim 1 wherein said conical insert is firmly connected to said spinning head through its rearwardly extending feed conduit to flanged supporting means closing the rearward end of said annular outer feed space.

15. An improved spinning device for the production of a plurality of bicomponent filaments which comprise:

a spinning head in the form of a hollow, substantially cylindrical housing;

a circular nozzle plate containing spinning orifices held in place on the front face of said housing;

a circular distributor plate superimposed behind said nozzle plate within said housing and having radially extending chambers formed by side walls extending forwardly to intersect the spinning orifices contained in said nozzle plate;

a conically-shaped insert with its circular base superimposed behind said distributor plate within said housing and having alternate inner and outer radial slots aligned with corresponding slots extending through the distributor plate into said radial channels, the outer slots extending through an outer circumferential portion of said conically-shaped insert to connect with an outer feed space in said housing and the inner slots extending inwardly from a central annular area of the base of said insert to connect with an inner feed space along the axis of the housing; and

partition means in said housing to separate said inner feed space from said outer feed space, said partition means including the conically tapered rear wall structure of said insert.

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