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Lenk

[11] **3,891,379**

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[54] **SPINNING HEAD WITH AN EXCHANGEABLE, SELF-SEALING NOZZLE ASSEMBLY**

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[73] Assignee: **Barmag Barmer Maschinenfabrik Aktiengesellschaft,** Wuppertal, Germany

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **425/464;** 425/382.2; 425/192

[51] **Int. Cl.** **B29f 3/04**

[58] **Field of Search** 425/464, 461, 182, 192, 425/382.2

[56] **References Cited**

UNITED STATES PATENTS

2,148,003	2/1939	Wurtzel	425/464
2,385,856	10/1945	Hayes	425/464 X
3,480,995	12/1969	Lenk	425/464
3,669,584	6/1972	Yamada et al.	425/192 X
3,762,854	10/1973	Kilsdonk	425/464 X

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[57] **ABSTRACT**

A spinning head for the melt spinning of thermoplastic polymers, with a nozzle assembly which is withdrawable and insertable from the service end of the spinning head in drawer-like fashion, and is designed for self-sealing under the action of the melt pressure. The nozzle assembly is releasably connected to the stationary melt-supplying member with the aid of longitudinally extending cooperating guideways on this feed member and on the casing of the nozzle assembly, respectively, and these guideways are so disposed that the melt pressure sets up substantially only tensional stresses in the melt casing. This design makes it possible to reduce the thickness of the casing, and it is easier to gain access into the nozzle assembly for inspection and cleaning.

10 Claims, 6 Drawing Figures

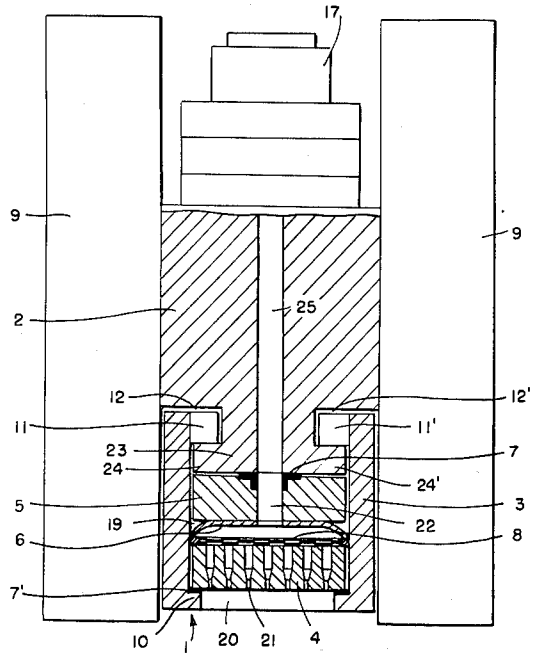

FIG. 1

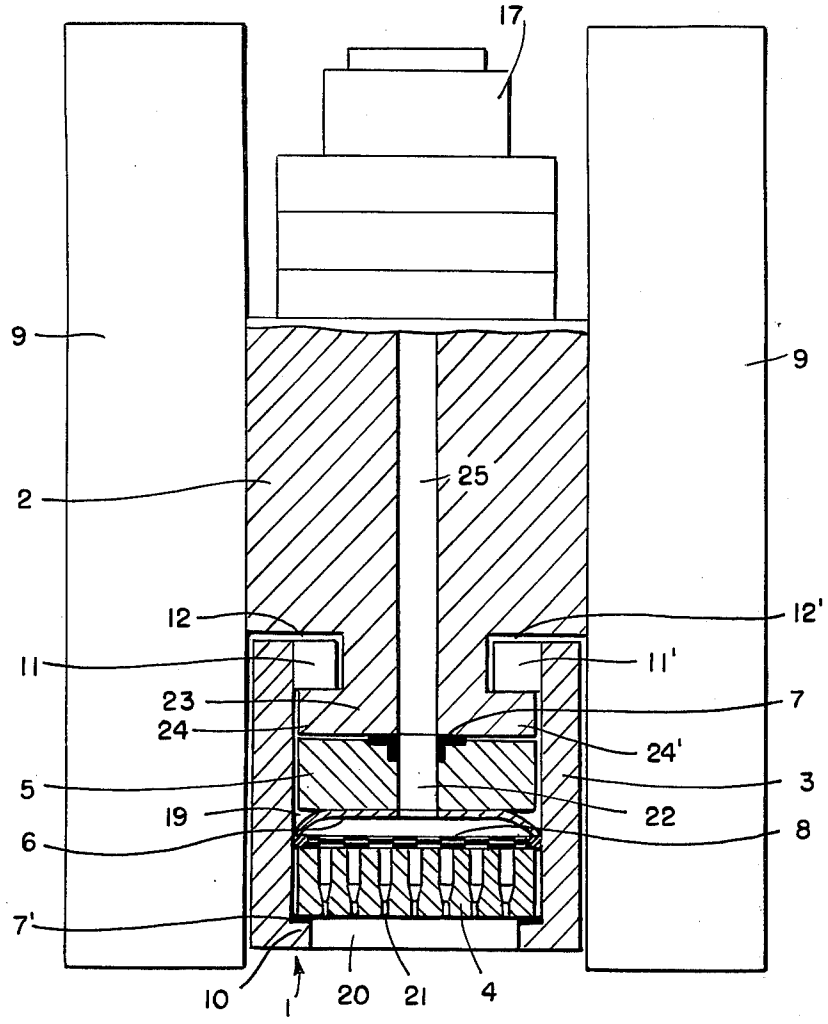
17
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FIG. 4

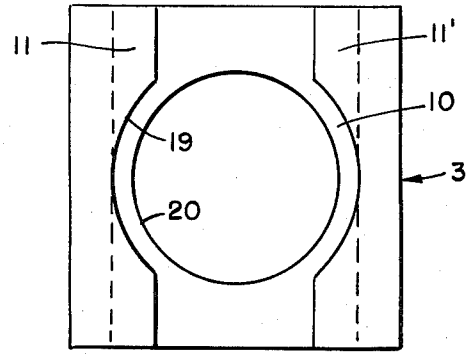
11
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FIG. 2

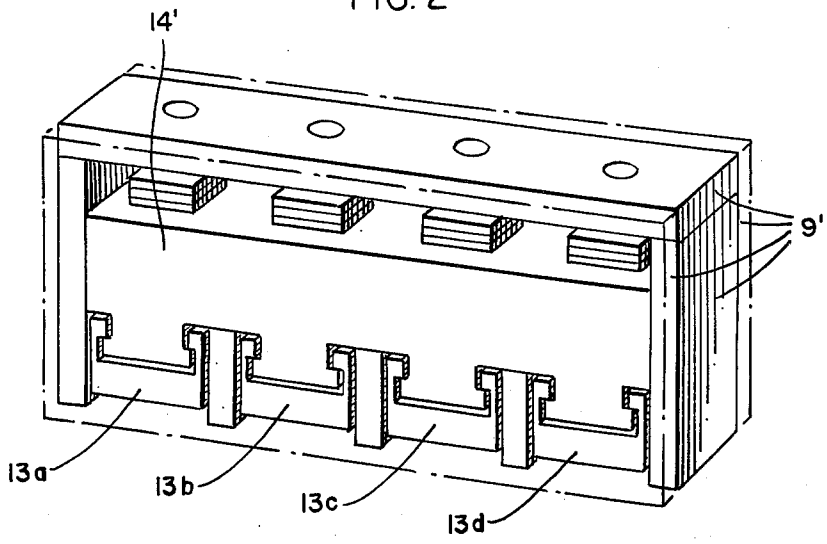


FIG. 3

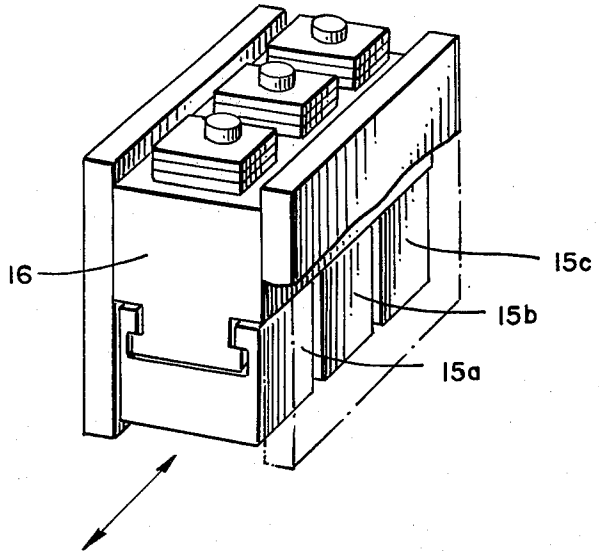


FIG. 5

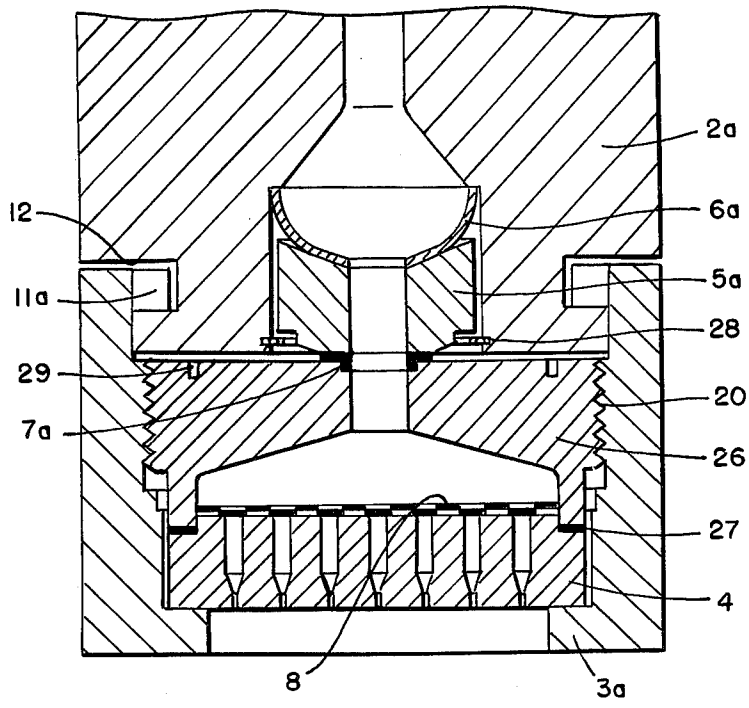
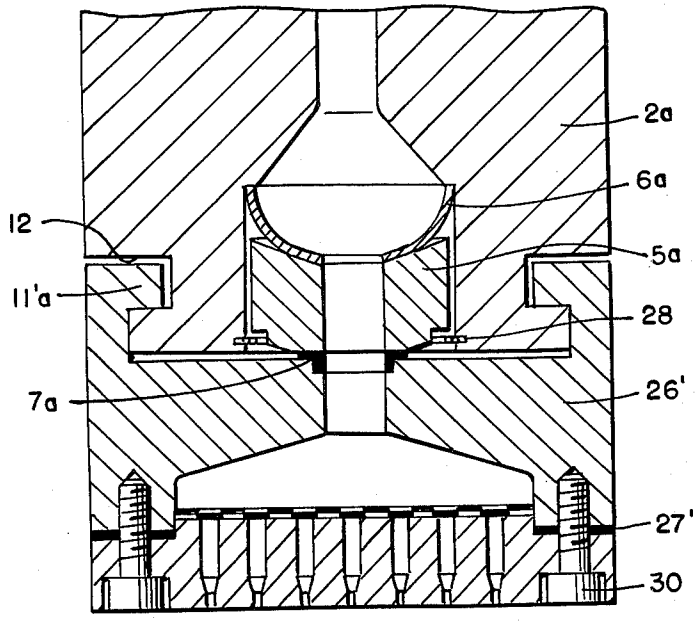


FIG. 6



SPINNING HEAD WITH AN EXCHANGEABLE, SELF-SEALING NOZZLE ASSEMBLY

The invention relates to spinning heads for the spinning of thermoplastic polymers, and more particularly to such spinning heads which permit easy removal of the nozzle assembly proper for the purpose of cleaning or replacement. The invention also relates to multi-unit spinning head apparatus of this general kind.

Spinning heads are known wherein the nozzle assembly may be withdrawn and inserted in an axial direction, usually from the lower end of the spinning head. Representative of this "hanging" type of construction are German published patent application No. 1,660,375 and German Pat. No. 1,246,221, for example. In these known spinning heads clamping means in the form of vertically extending bolts or threaded clamping rings are provided by which the nozzle assembly is pressed upwardly against the member through which the melt is supplied to the top of the nozzle assembly. The pressure thus mechanically exerted on the various seals which keep the melt from leaking to the outside of the nozzle assembly is supplemented by the melt pressure itself which in these designs tends to urge the different parts of the nozzle assembly away from each other and against the seals. In the case of German Pat. No. 1,246,221 these parts include an annular piston designed to step up the pressure applied by the melt to the principal seal.

Spinning heads of this known construction have the disadvantage that vertical space must be set aside underneath the spinning head for the removal of the nozzle assembly. Also, since in arrangements of this kind the spinning chute is typically located in this general dismounting area, the chute interferes with the withdrawal and insertion operation and must be made of movable design. In the case of multi-unit spinning head apparatus, moreover, it becomes impossible during the exchange of one of the nozzle assemblies to continue operation with one of the other nozzle assemblies. In addition, the forces involved in sealing the nozzle assembly and securing it to the stationary feed member are large and their distribution is disadvantageous so that the resulting design is relatively bulky.

Spinning heads have been proposed in which the above mentioned disadvantage of lost space underneath the nozzle assembly is avoided by making this assembly removable in a lateral direction, i.e., in a direction generally perpendicular to the axis of the spinning head. In these arrangements the stationary feed member at its lower extremity is generally in the shape of a "C" which is open towards the service side of the spinning head. The bottom leg of this C forms a ledge by which the nozzle assembly is supported and on which the nozzle assembly can be moved outwardly or inwardly in drawer-like fashion.

In German published patent application No. 1,276,861 the foregoing construction is implemented by means of wedges which are supported by the aforementioned bottom leg of the C-shaped stationary member and which cooperate with inclined, downwardly facing surfaces on the nozzle assembly. The wedges can be drawn against the rear wall of the C by means of bolts and, as a result, the nozzle assembly is pressed against a seal at its top, thereby to seal the nozzle assembly at the point of melt supply.

In my own German published patent application No. 1,529,819 self-sealing is used, i.e., the sealing of the nozzle assembly is effected under the action of the melt pressure, with preloading by resilient means interposed between the die plate and a piston which is axially movable and carries a seal at least at its upper end.

While my last-mentioned design in other respects is satisfactory, this design, as well as that according to the above German application Pat. No. 1,276,861, suffers from the drawback that the relatively large forces exerted on the C shaped portion of the stationary member subject this portion to bending stresses and tend to spread the two legs of the C apart. As a consequence this portion, and particularly the bottom leg of the C, must be made relatively thick and this renders the design rather voluminous and heavy. These larger dimensions, in turn, adversely affect the visibility of the nozzle assembly from the service side of the spinning head and also detract from the accessibility of the nozzle assembly in cleaning operations.

It is an object of the invention to provide a spinning head exhibiting the advantages of the known designs without being subject to their disadvantages.

More particularly, it is an object of the invention to provide a spinning head in which the nozzle assembly is connected to the melt-supplying member in a way affording desirable distribution of forces, and so that these forces are transmitted to the melt-supplying member directly; that the advantageous drawer-type design is retained; and that, in the instance of a multi-unit spinning head apparatus, if one of the nozzle assemblies is being exchanged, spinning may be continued with an adjacent nozzle assembly.

According to the principle aspect of the invention the foregoing objects are obtained, briefly, by providing on the stationary feed member and on the casing member forming the holding element of the nozzle assembly, elongated cooperating guideways — formed for instance by guide bars of generally rectangular cross section — so that this casing with the spinning elements therein may be laterally withdrawn from and inserted in the spinning head. The aforementioned guideways are disposed so that the self-sealing forces which are due to the action of the melt pressure substantially set up, in a direction parallel to the axis of the spinning head, merely tensional stresses in the above casing. Preferably, one of the two members thus releasably secured together has formed therein adjacent its guide bars, guide grooves in which the guide bars of the other member slide. The mating faces of the guideways may be plane or they may be of dove-tail design. In addition to the aforementioned spinning elements — say a die plate and a filter — the casing may also contain a piston with a passage therein for the melt and a resilient or deformable sealing element such as an annular diaphragm cooperating with the piston to facilitate self-sealing under the action of the melt pressure.

In the design according to the invention the nozzle assembly can be moved from the service side of the spinning head in drawer-like fashion, and because of this transverse direction of movement of the nozzle assembly, the latter can be exchanged simply and quickly. The melt pressure is utilized both for self-sealing and for providing the clamping forces between the nozzle assembly and the feed member carrying this assembly, effective directly by way of the aforementioned guideways. In this fashion a force distribution is

obtained which involves loops of lines of force closed over the cooperating parts of the guideways, the lengthwise extent of the casing, and a support provided adjacent its lower end. Because of the tensional nature of the stresses set up in the casing only thin walls are required for the latter, thereby reducing the space occupied by the casing.

By virtue of this design the dimensions of the spinning head itself can be similarly reduced and this in turn reduces the space requirements of the heat box surrounding it. Also, because of the reduced dimensions of the casing of the nozzle assembly, visibility of the spinning assembly from the service side and accessibility in cleaning its parts are greatly enhanced.

A design of comparable merits is obtained by the use of the principles of the invention if the piston with its bore, which is provided to facilitate self-sealing, is mounted along with the diaphragm element as a part of the feed member carrying the nozzle assembly, rather than as a part of the nozzle assembly itself.

According to another feature of the invention the plurality of nozzle assemblies disposed one behind the other in the direction of insertion may be associated with a common member carrying them, in drawer-like fashion, by means of guideways of the kind mentioned.

According to yet another feature of the invention a plurality of nozzle assemblies disposed side by side with respect to the direction of insertion may be so associated with a common carrying member.

These multi-unit arrangements result in compact designs which may advantageously include a single heat box surrounding the entire spinning head assembly.

Illustrated embodiments of the invention will now be described with reference to the accompanying drawings, in which:

FIG. 1 is a part-sectional front view of a spinning head according to the invention, including melt-supplying member, metering pump, heat box, and an exchangeable nozzle assembly;

FIG. 2 schematically illustrates a multi-unit spinning head apparatus according to the invention in which a plurality of nozzle assemblies are arranged side by side;

FIG. 3 schematically illustrates a multi-unit spinning head apparatus according to the invention in which a plurality of nozzle assemblies are arranged one behind the other; and

FIG. 4 is a plan view of a casing, taken by itself, of the nozzle assembly of the spinning head as in FIG. 1.

FIGS. 5 and 6 are sectional front views of two other alternative embodiments of the invention.

Referring now to FIG. 1, the spinning head illustrated in this figure substantially comprises a stationary feed member 2 having a vertical passage 25 therein through which the melt is fed under the control of metering pump 17. Reference numeral 9 denotes the side walls of a heat box enclosing the spinning head.

Feed member 2 carries a nozzle assembly 1 having a generally cube-shaped, thin-walled retaining or casing member 3 shown in plan view in FIG. 4. As will be seen from the two figures, casing 3 has a cylindrical cavity or well 19 therein which is open at the front and rear as viewed in FIG. 1, and also has a cylindrical melt-discharge opening 20 at the bottom, which is defined by the inner wall of supporting flange 10 of casing 3. Stacked within cylindrical cavity 19 of casing 3 are spinning elements including a cylindrical die plate 4 having spinning orfices or nozzles 21 therein, a likewise cylindrical filter element 8 associated with this die plate, and a cylindrical piston 5 having a central bore 22 aligned with feed member passage 25. Abutting the bottom face of the piston, in sealing or connected relationship such as by heat deformation or by welding, is a disc-shaped metallic member or diaphragm 6 which is similarly sealed at its periphery to that of filter 8. Diaphragm 6 has a central aperture therethrough. On its top side piston 5 is provided with a gasket or sealing means 7 designed to form a seal with respect to the bottom face of a lower extension 23 of feed member 2. Another gasket 7' is preferably inserted between flange 10 and plate 4.

This extension 23 has a depth — that is a front-to-rear extent not visible in FIG. 1 — which corresponds to that of casing 3, and it has the shape of an inverted T. The horizontal legs 24, 24' of this T are of rectangular cross section and form ledges or guide bars for the sliding movement of the nozzle assembly in the withdrawal and insertion of the latter, and they leave above them corresponding rectangular guide grooves 12 and 12' which mate, respectively, with inwardly extending guide bars 11 and 11' of rectangular cross section which are formed at the top end of casing 3. The guide bars 11, 11' and 24, 24' form guideways which serve to mechanically couple nozzle assembly 1 to feed member 2 in the operating condition of the spinning head while, at the same time, affording means for the withdrawal of nozzle assembly 1 from and its insertion into the spinning head from the service end (the front end of FIG. 1) of the spinning head in a direction normal to the axis of the latter in drawer-like fashion. As will be appreciated from FIGS. 1 and 4, once the nozzle assembly has been withdrawn, die plate 4, filter 8 and piston 5 with diaphragm 6 and sealing means 7, can be removed from casing 3 from the top end thereof for inspection, repair or replacement. Similarly, casing 3 is originally loaded, or is reloaded, with these parts from the top.

In the operation of the spinning head the pressure of the melt supplied through passage 25 and bore 22, through the medium of filter 8 urges die plate 4 against support flange 10 of casing 3 and, on the other hand, urges axially movable piston 5 with its sealing element 7 against the bottom face of extension 23 of stationary feed member 2; diaphragm 6 expands or is deformed in the process. In this fashion the melt pressure functions to provide an auotmatic seal both with respect to feed member 2 and casing member 3. At the same time the melt pressure operates to securely connect the nozzle assembly mechanically to the feed member and, in doing so, acts via legs or guide bars 24, 24' and 11, 11', and via flange 10 at the bottom end of casing 3, to set up in the wall of this casing substantially only tnesional stresses which extend in a direction parallel to the axis of the spinning head.

Feed member 2 and nozzle assembly 1 are thus locked together under the action of the melt pressure, by loops of lines of force which are closed over the aforementioned guideways, the axial or lengthwise extent of casing 3, and flange 10 in series. It is due to the tensional character of the stresses in casing 3 that its dimensions can be held to a minimum, and this in turn results in the improved properties of the design according to the invention from the standpoint of visibility and accessibility of the nozzle assembly. Also, no space for the dismounting of the nozzle assembly is lost therebelow.

FIG. 2 shows a multi-unit spinning head in which a plurality of nozzle assemblies — the four assemblies, 13*a*, 13*b*, 13*c*, 13*d* in the example illustrated — are carried and served by a common stationary feed member 14′ having a corresponding number of melt passages (not shown). This common member is enclosed by a heat box 9′. As indicated in FIG. 2, the nozzle assemblies are designed — in particular, connected to the feed member and sealed — in a manner explained above in conjunction with FIGS. 1 and 4. The four nozzle assemblies are mounted in side-by-side relationship, that is, they are aligned in a direction perpendicular to that of withdrawal and insertion of the assemblies.

FIG. 3 illustrates a multi-unit spinning head in which a number of nozzle assemblies 15*a*, 15*b*, 15*c*, are similarly carried and served by a common stationary feed member 16. Again, the design of the nozzle assemblies and their connection to the feed member corresponds to the technique described hereinabove with respect to FIGS. 1 and 4. The nozzle assemblies are aligned in this embodiment one behind the other, that is, in a direction parallel to the direction of withdrawal and insertion of the assemblies. This arrangement lends itself for installations in which two or three assemblies are to be so placed with respect to each other.

The arrangements of FIGS. 2 and 3 make it possible to provide a large number of easily and quickly replaceable nozzle assemblies in a relatively limited space. Self-sealing and secure mounting take place under the action of the melt pressure and the assemblies can be easily observed and cleaned from the service side, all as previously explained.

As indicated above, instead of providing the piston with its diaphragm, in the casing of the nozzle assembly, it is also possible to slidably mount the piston in the stationary feed member. Also, while the cooperating guide bars on the two members have been shown with plane mating faces, it is also possible to provide the cooperating guide bars with dove-tail shaped work surfaces instead.

Referring to the embodiments shown in FIGS. 5 and 6, the feed member 2*a* has an enlarged bore at the end of the vertical feed passage 25*a* to receive a cylindrical piston 5*a* and the diaphragm 6*a* which cooperate under the influence of the melt pressure to produce a tight seal with the nozzle assembly over the annular gasket or sealing element 7*a*. The piston and diaphragm combination is supported by the spring retention ring 28 which may also be used to prestress or place an initial tension on the sealing element 7*a* before the melt is introduced.

In all embodiments of the invention, the diaphragm 6 or 6*a* may be composed of a resilient metal such as a corrosion-resistant steel alloy which may be welded to the piston along an inner edge or surface such that there is a resilient or elastic displacement of the diaphragm under melt pressure and an ability to spring back when this melt pressure is relieved. It is especially advantageous, however, to employ a diaphragm which is a deeply drawn sealing element composed of aluminum, and which is simply inserted into its correct position during assembly of the spinning unit. Under high melt pressure and temperature, this aluminum disc or diaphragm undergoes deformation so as to be applied in a tight and close fitting relationship with the abutting wall members. Such an aluminum sealing element then serves as a simple throwaway gasket which is replaced during each reassembly of the spinning head. Because of the high viscosity of the melt, it is practically impossible for any leaks to occur in the self-sealing arrangement. Also, such a deformable gasket or seal offers a large area of surface contact with the melt to transmit pressure to the relatively smaller annular surface are of the sealing means 7 or 7*a*.

In FIG. 5, the nozzle plate 4 with filter pack 8 is fixed in place within the casing 3*a* by the pressure exerted through the threading 20 of the cover member 26 having a cylindrical shape and being sealed against the nozzle plate 4 by the annular gasket 27. Key holes, slots 29 or the like, can be provided in the upper face of cover member 26 to permit the insertion of a tool in tightening or loosening this threaded member.

In FIG. 6, the nozzle plate 4 with filter 8 is directly secured to the casing 26′ which is integral with the covering means above the nozzle assembly, i.e., so as to provide a unitary casing and nozzle assembly similar to FIG. 6. One advantage of these alternative embodiments resides in the reinforcement of the casing 3 or 26′ by joining the nozzle plate 4 and/or the covering means 26 or 26′ to each other. Members 11*a* or 11*a*′ still cooperate with the grooved portion 12 of the feed member 2*a* to permit the sliding insertion or removal of the casing and nozzle assembly laterally of the feed member. Moreover, sealing or clamping forces and tensions in the lower drawer-like structure, as exerted by the melt pressure, still extend substantially only in an axial direction without any tendency to damage or distort the self-sealing structure. This additional strengthening of the withdrawable nozzle and casing units does not prevent a rapid interchange of such units, although they do require some additional time for complete disassembly or reassembly of their component parts. On the other hand, the embodiment of FIG. 6 has the further advantage that it can have a nozzle plate in the form of a rectangular die or so-called "line die". These and similar alternative constructions within the scope of the invention will be readily understood by those skilled in this art.

This invention is hereby claimed as follows:

1. A spinning head for the spinning of thermoplastic polymers around a vertical axis, including a relatively stationary feed member supplying the melt, a nozzle assembly laterally withdrawable from and insertable in said spinning head and connectable to said feed member in self-sealing relationship under the action of the melt pressure, said nozzle assembly comprising a casing member and, supported by and retained in said casing member, spinning elements including at least a die plate, elongated cooperating guideways being respectively provided on said feed member and said casing member for the withdrawal and insertion of said casing member with said spinning elements therein, said guideways being disposed so that the self-sealing forces due to the action of the melt pressure give rise, in a direction parallel to the vertical axis of said spinning head, substantially to only tensional stresses in said casing member.

2. A spinning head as claimed in claim 1, wherein said casing member adjacent its lower end has an inwardly extending support portion against which said die plate bears when subjected to said melt pressure.

3. A spinning head as claimed in claim 2, wherein said guideways comprise cooperating guide bars on said two members, respectively, said cooperating guide

bars being urged by said melt pressure against each other, and one of said members having formed therein adjacent its guide bars, guide grooves in which the guide bars of the other member ride.

4. A spinning head as claimed in claim **1**, wherein said spinning head further includes a piston containing a bore aligned with a passage in said feed member.

5. A spinning head as claimed in claim **4**, wherein said spinning head also includes sealing means interposed between said piston on the one hand and a filter associated with said die plate on the other hand.

6. A spinning head as claimed in claim **5**, wherein said piston and said sealing means are part of said nozzle assembly, said piston being mounted for slidable movement in said casing member.

7. A spinning head as claimed in claim **5**, wherein said piston and said sealing means are mounted in said feed member.

8. A multi-unit spinning head apparatus having a plurality of nozzle assemblies, said appratus including a relatively stationary feed member common to said nozzle assemblies for supplying the melt to the individual assemblies, each said nozzle assembly being laterally withdrawable from and insertable in said feed member and connectable to said member in self-sealing relationship under the action of the melt pressure, and each comprising a casing member and, supported by and retained in said casing member, spinning elements including at least a die plate, and said apparatus further including a plurality of elongated cooperating guideways respectively provided on said common feed member and on the individual casing members, for the withdrawal and insertion of any of said casing members with the corresponding elements therein, each of said plurality of cooperating guideways being disposed so that the self-sealing forces due to the action of the melt pressure give rise, in a direction parallel to the axis of the corresponding nozzle assembly, substantially to only tensional stresses in the respective casing member.

9. A multi-unit spinning head appratus as claimed in claim **8**, wherein said plurality of nozzle assemblies are mutually aligned in a direction normal to the direction of withdrawal and insertion of said assemblies.

10. A multi-unit spinning head apparatus as claimed in claim **8**, wherein said plurality of nozzle assemblies are mutually aligned in a direction parallel to the direction of withdrawal and insertion of said assemblies.

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