

The invention relates to a self-sealing nozzle unit for a spinning head of a spinning machine for spinning continuous fibres from a viscous spinning liquid under high pressure, consisting of a nozzle pot, into which a nozzle plate is incorporated and which is covered by a filter pack, a piston-like pressure piece which is axially movable in the nozzle pot and has a central channel, the upper surface of which is adjacent to the lower surface of a manifold block having at least one channel, an upper seal between the pressure piece and the manifold block, a central seal for sealing the space above the filter pack with respect to the nozzle pot, and a lower flat annular seal for sealing the nozzle pot at the bottom.

Such a self-sealing nozzle unit and its mode of action are disclosed in US-A-4 494 921, EP-A2-0 300 120 and EP-B1-0 163 248. This known nozzle unit may also have a further manifold plate (perforated plate) between the nozzle plate and the filter pack, the manifold plate being pot-shaped at the top for accommodating the filter pack (EP-B1-0 163 248; reference numeral 27).

This known nozzle unit is expensive and complicated in structure and, when used in operation, led to considerable problems and difficulties. The upper seal caused a gap to be formed between the upper surface of the pressure piece and the lower surface of the manifold block. High melt pressure, high contact pressure and high melt temperatures caused gradual deformation and contraction of the seal on account of the sealing material flowing into this gap. This caused a dead space to be formed in which polymer degradation occurred on account of the long dwell time of the melt. Furthermore, at this point, leaks occurred repeatedly. The same problems, namely deformation and tearing of the seal, formation of dead spaces (dead water zones), polymer degradation and leaks, also occurred,

particularly at the metallic diaphragm seal (which is also expensive to produce) and consequently also at the lower seal. This known nozzle unit therefore has a total of three seals, two of which are inadequate and one of which, the metallic diaphragm seal, is relatively expensive. A further disadvantage was that, on account of the diaphragm seal, a relatively large clearance was formed therebelow, which led to an undesirably long dwell time for the spinning liquid, particularly with low fibre titres, resulting in an undesirable change therein, polymer degradation and the like.

Consequently, the present invention was based on the object of providing a self-sealing nozzle unit of the type under consideration, which no longer has the disadvantages specified above, which is particularly reliably self-sealing and thus more operationally reliable, which has a simpler structure and is thus cheaper, and which has a smaller clearance above the filter pack, leading to a reduction in the dwell time of the spinning liquid in this region. A subsidiary aim was to be able to achieve an increase in the filter surface area of the filter pack, even when using a manifold plate (perforated plate).

This object was achieved according to the invention with the self-sealing nozzle unit of the type described at the start in that the upper seal is tubular, has an internal diameter that corresponds to the diameter of the central channel of the pressure piece and the channel of the manifold block and extends into both channels, that the upper surface of the pressure piece lies firmly against the lower surface of the manifold block under operating conditions, that the pressure piece is pot-shaped at the bottom in order to accommodate the filter pack and optionally a manifold plate, and that the central seal is also tubular and covers and seals the annular gap between

the nozzle pot and the edge of the pot-like form of the pressure piece.

The principle of the solution on which the invention is based therefore consists of developing the pressure piece, which is movable in the nozzle pot, so that annular gaps are formed at the top between the pressure piece and the manifold block and at the bottom between the pressure piece and the nozzle pot or the manifold plate, the annular gaps initially extending radially from the inside to the outside, wherein the width of the annular gaps (gap width) optionally changes during operational use, and that these annular gaps are each covered by a tubular seal so that the seals are pressed radially outwards onto the annular gap by the pressurised spinning liquid and thus cause a fluid-tight seal. It must be viewed as surprising that, even if the annular gaps are increased or reduced in size by an axial movement of the piston-like pressure piece in the nozzle pot, no leaks occur, even if the pressure of the spinning liquid is increased and reduced several times and the pressure piece is thereby repeatedly moved axially in and out, generally, therefore, up and down.

In a particularly preferred embodiment, the central tubular seal is the arm, pointing upwards and/or downwards, of a seal having an L-shaped cross-section (angular seal). In this case, the central tubular seal, i.e. the angular seal, may be arranged above the nozzle plate, wherein the upper portion of the seal or the arm pointing upwards of the angular seal extends into the pot-like form of the pressure piece, i.e. projects into the pot-like form of the pressure piece.

A substantial aspect of the invention is that the sealing effect of the upper and central tubular seals or of the arm, pointing upwards and/or downwards, of the angular seal

The filter pack may have the conventional means conforming to the prior art, such as screens with different mesh sizes, filter granules, for example sand, with different grain sizes, discs made of sintered materials, etc. If loose filter granules are used, the manifold plate is usefully provided with a narrow border at the top, the height of which corresponds to the bulk height of the layer of filter granules. Its design with respect to structure, height, choice of filter medium, etc, is based on the type of viscous spinning liquid, which may be the melt of thermoplastic polymers, such as polyester, polyamide, etc, a solution such as polyacrylonitrile in solution with DMF, or other materials.

Soft aluminium, in particular, has proven to be the best material for the seals, although soft iron and other easily deformable materials are also suitable. Suitable materials are those which permanently withstand the sometimes high temperatures of the spinning liquid, which, in the case of polymer melts, for example, can be up to 450 °C.

The central channel in the pressure piece may have the same diameter or cross-section over its entire length, but it may also have a diameter or cross-section that increases or reduces in the direction of flow, i.e. a conical form. In particular, a mixing element, preferably a so-called static mixer, may be arranged in the channel of the pressure piece.

The nozzle pot may be fixed to the manifold block with conventional means such as screws or in another manner. A connection which has proven to be particularly advantageous and is known per se uses a multiple thread which is arranged on the outer periphery of the lower portion of the manifold block and, as a counterpart cooperating therewith, on the inner periphery of the upper portion of the nozzle

pot. In this way, it is possible to achieve sufficiently permanent fixing of the nozzle pot with a turn of just 180° or certainly 360° thereof. The important factor is that the lead of the thread should be small so that self-locking is achieved to prevent this screwed connection loosening of its own accord. Otherwise, another means of securing against turning, for example a locking pin, should be provided.

The shape and dimensions of the nozzle unit and its parts are subject to no restrictions - neither at the top nor at the bottom - and are adapted to the requirements in each case.

A further substantial advantage of the nozzle unit according to the invention is that its self-sealing effect always occurs reliably, even after several - intentional or unintentional - complete drops or reductions in pressure.

The invention will now be explained in greater detail with reference to the figures. The figures, some in simplified form, show:

- Figure 1 a particularly preferred embodiment of the nozzle unit in longitudinal section,
- Figure 2 an embodiment of the pressure piece in longitudinal section,
- Figures 3 to 7 further embodiments of the nozzle unit in longitudinal section,
- Figure 8 a double angular seal in longitudinal section.

In the figures, the following reference numerals designate the following parts:

- 1 Nozzle pot
- 2 Nozzle plate
- 3 Filter pack
- 4 Pressure piece
- 5 Upper surface of the pressure piece
- 6 Pot-like form of the pressure piece
- 7 Space above the filter pack
- 8 Manifold block
- 9 Lower surface of the manifold block
- 10 Upper seal
- 11 Manifold plate; perforated plate
- 12 Central channel of the pressure piece
- 13 Angular seal
- 14 Arm, pointing axially upwards and/or downwards, of the angular seal; central seal
- 15 Arm, pointing radially inwards, of the angular seal; lower seal
- 16 Annular gap
- 17 Multiple thread
- 18 Nozzle openings
- 19 Channel of the manifold block
- 20 Edge of the pot-like form of the pressure piece
- 21 Assembly holes
- 22 Widening of the channel 12

Figure 1 illustrates the following parts, the arrangement, function and mode of action of which have already been described in detail: the nozzle pot 1, which is fixed to the lower end of the manifold block 8 with the aid of the double, triple or quadruple thread 17, the nozzle plate 2 arranged therein having the nozzle openings 18, the manifold plate 11 designed as a perforated plate, the angular seal 13 having the arm 14 pointing axially upwards and the arm 15 pointing radially inwards, the filter pack 3, the space 7 above the filter pack 3, the pressure piece 4 having the central channel 12 and the pot-like

form 6 in the lower portion of the pressure piece 4, for accommodating the filter pack 3 and the perforated plate 11, which projects over the edge 20 of the pot-like form 6, the annular gap 16 between the edge 20 and the step of the nozzle pot 1 at this point, which is covered and sealed by the arm 14 of the angular seal 13, the upper surface 5 of the pressure piece 4, which lies firmly against the lower surface 9 of the manifold block 8 without leaving a gap, the upper seal which covers and seals the gap between the surfaces 5 and 9 and projects into the channel 12 of the pressure piece 4 and the channel 19 of the manifold block 8. The internal diameter of the upper seal 10 is equal to the diameter of the channels 12 and 19 so that, in this manner, a smooth feeder channel without projections is formed for the spinning liquid. The arm 14 of the seal 13 seals the space 7 above the filter pack 3 with respect to the gap between the pressure piece 4 and the nozzle pot 1, in order to prevent spinning liquid penetrating into this gap. Thus, in a substantially simpler and more reliable manner, it performs the same function as used to be performed by the expensive and fault-prone diaphragm seal of the prior art. The arm 14 of the seal 13 - considered on its own - is tubular and the arm 15 - considered on its own - has the shape of a flat seal (flat seal). The arm 14, when pressurised, seals radially inwards (radial pressure components) and the arm 15, when pressurised, seals axially inwards (axial pressure components). In place of the perforated plate 11, as illustrated in figure 1, the nozzle plate 2 may also be arranged at this point. An appropriate forward-projecting contact surface for supporting the nozzle plate 2 should then be provided on the inner surface of the nozzle pot 1.

With simple means and tests it is also possible to design and determine a suitable embodiment of the nozzle unit in

which the angular seal 13 can be incorporated another way round, i.e. with the axial arm 14 pointing downwards.

Figure 2 illustrates an embodiment of the pressure piece 4. The parts 5; 6; 7; 10; 12 and 20, which have already been explained above with respect to figure 1, will not be enumerated and described again here. Reference numeral 21 designates one of three, for example, holes which facilitate fixing of the pressure piece 4 during the insertion of the filter pack 3 and optionally the manifold plate 11 by means of an appropriate number of pins arranged on a support. To this end, the pressure piece 4 is arranged the other way round, i.e. with the surface 5 at the bottom. The upper end section of the channel 12 has the widening 22 for accommodating the lower portion of the seal 10.

The embodiment illustrated in figure 3 differs from the embodiment illustrated in figure 1 only in that the central tubular seal 14 and the lower flat seal 15 are not parts of an angular seal. Here, the lower flat seal 15 is arranged beneath the nozzle plate 2. Since all the other parts are identical to the parts illustrated in figure 1, no further description of this embodiment will be provided.

The embodiments illustrated in figures 4 to 7 differ substantially only in the design of the pressure piece 4 and of the perforated plate 11, if present, and the design and arrangement of the seals 14 and 15. All the other parts are consequently only provided with reference numerals if they are specified in the following description. In addition, the upper parts and the filter pack 3 are omitted from figures 5 to 7. A more extensive description of these figures than the following is given with reference to the description of figures 1 to 3.

Figure 4 illustrates an embodiment in which no manifold plate 11 is used, with the result that the filter pack 3 lies directly on the nozzle plate 2. Here, the central tubular seal 14 and the lower flat seal 15 are again formed by the arm of an angular seal 13. In this embodiment, this angular seal 13 is arranged beneath the nozzle plate 2.

In the embodiment illustrated in figure 5, the central tubular seal 14 is arranged above the manifold plate 11 and the lower flat seal 15 is arranged between the manifold plate 11 and the nozzle plate 2. Here, the manifold plate 11 is not flat at the top, but rather is pot-shaped - for example in order to accommodate filter granules, such as sand or the like. The central tubular seal 14 projects into the pot-shaped portion of the manifold plate 11 and of the pressure piece 4 and lies against the inner surface of the "edge of the pot". The annular gap 16 is clearly visible between the lower edge of the pot-like form of the pressure piece 4 and the upper edge of the pot-shaped development of the manifold plate 11, which is covered by the central tubular seal 14, even if it is intended to be enlarged, for example to twice the width, by the upwards movement of the pressure piece 4.

The embodiment illustrated in figure 6 substantially corresponds to the embodiment illustrated in figure 5, wherein, however, the central tubular seal 14 is arranged in an annular groove which is arranged at the lower end of the pot-like form of the pressure piece 4 and at the upper end of the pot-like form of the manifold plate 11.

The embodiment illustrated in figure 7 substantially corresponds to the embodiment illustrated in figure 5. In this embodiment, the annular gap 16 leading radially outwards and covered by the central tubular seal 14 does not, however, extend horizontally, as in the previously

described embodiments, but rather extends obliquely upwards. It could equally extend obliquely downwards. The sealing effect is not influenced by this.

Figure 8 shows a double angular seal in longitudinal section, by which the central tubular seal 14 is formed by both the arm pointing upwards and the arm pointing downwards 14a and 14b. Here, the lower flat seal 15 is also formed by the arm pointing inwards, as in a simple angular seal. With simple means and tests it is possible to design a suitable embodiment of the nozzle unit in which this double angular seal may be used successfully.



1. A self-sealing nozzle unit for a spinning head of a spinning machine for spinning continuous fibres from a viscous spinning liquid under high pressure, consisting of a nozzle pot (1), into which a nozzle plate (2) is incorporated and which is covered by a filter pack (3), a piston-like pressure piece (4) which is axially movable in the nozzle pot and has a central channel (12), the upper surface of which is adjacent to the lower surface of a manifold block (8) having at least one channel, an upper seal (10) between the pressure piece and the manifold block, a central seal (14) for sealing the space above the filter pack with respect to the nozzle pot, and a lower flat annular seal (15) for sealing the nozzle pot at the bottom, characterised in that the upper seal (10) is tubular, has an internal diameter that corresponds to the diameter of the central channel of the pressure piece or the channel of the manifold block and extends into both channels, that the upper surface of the pressure piece (4) lies firmly against the lower surface of the manifold block under operating conditions, that the pressure piece (4) is pot-shaped at the bottom in order to accommodate the filter pack (3) and optionally a manifold plate (11), and that the central seal (14) is also tubular and covers and seals the annular gap between the nozzle pot and the edge of the pot-like form of the pressure piece.
2. A nozzle unit according to claim 1, characterised in that the central tubular seal (14) is the arm, pointing upwards and/or downwards, of a seal having an L-shaped cross-section.



3. A nozzle unit according to claim 1 or 2, characterised by a manifold plate (11) that is flat at the top and is arranged above the nozzle plate and below the filter pack.
4. A nozzle unit according to at least one of claims 1 to 3, characterised by a static mixing element arranged in the channel of the pressure piece.