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(54) **A machine manufacturing filters for tobacco products**

Maschine zur Herstellung von Filtern für Tabakprodukte

Machine de fabrication de filtres pour produits à base de tabac

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(56) References cited:
EP-A- 0 546 519 **EP-A- 0 594 054**
US-A- 3 050 430 **US-A- 3 173 188**

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Description

[0001] The present invention relates to a machine for manufacturing filters applicable to tobacco products, and in particular to cigarettes.

[0002] The manufacture of cigarette filters generally involves processing a continuous stream of filter material, such as cellulose acetate, which is drawn from a compacted bale.

[0003] In practice, the continuous stream of filter material consists in a high number (thousands) of continuous filaments.

[0004] Prior art manufacturing methods include a step of feeding the stream along a predetermined path through processing stations, where it is first stretched lengthwise and crosswise, and then wetted with chemical additives, typically triacetin.

[0005] At a further station located downstream of the aforementioned processing stations, the filter material is gathered into a continuous rope or bundle of cylindrical appearance by respective shaping means.

[0006] In certain prior art embodiments, the shaping means appear as a funnel-like duct into which the continuous stream is introduced, carried forward by a flow of air, its transverse dimension reducing gradually to the point that the filaments are drawn into a rope, or bundle, presenting a cross section substantially the same as that of a cigarette.

[0007] Once formed, the bundle passes through a further processing station where it is wrapped by degrees in a continuous strip of paper material, forming a continuous filter rod that will then be divided up into single plugs by a rotary cutter device.

[0008] The aforementioned flow of air that carries the stream through the funnel-like duct is admitted by way of an annular passage, connecting the duct to a source of pressurized air.

[0009] The annular passage is inclined relative to the feed direction of the continuous bundle, in such a manner that the pressurized air admitted via the passage will enter the duct and invest the outer surface of the bundle of filter material, assisting its progress toward the outlet of the duct, as for example described in documents EP 546519 and EP 594054.

[0010] It has been observed that in prior art machines, however, the continuous bundle is not transported uniformly through the funnel-like duct.

[0011] In effect, the air enters the annular passage at one or more localized points, with the result that the flow investing the continuous bundle as it forms internally of the duct is not homogeneous.

[0012] As a consequence of the drawback in question, the bundle is subject to asymmetrical thrust components that will translate into poor production stability, that is to say inconsistencies in the filtration properties presented by a given continuous bundle.

[0013] The object of the present invention is primarily to provide a machine for manufacturing filters applicable to tobacco products, such as will be unaffected by the drawback mentioned above.

[0014] In particular, the object of the invention is to provide a machine manufacturing filters for tobacco products that will convey the continuous bundle of filter material in a uniform manner.

[0015] A further object of the present invention is to provide a machine manufacturing filters for tobacco products, having the attributes needed to ensure good production stability.

[0016] The stated objects are realized according to the invention in a machine for manufacturing filters applicable to tobacco products, as characterized in one or more of the appended claims.

[0017] The invention will now be described in detail, by way of example, with the aid of the accompanying drawings, in which:

- figure 1 is a schematic illustration of a machine manufacturing filters for tobacco products, in accordance with the present invention;
- figure 2 illustrates a detail of the machine in figure 1, viewed in perspective with certain parts omitted better to reveal others;
- figure 3 illustrates the detail of figure 2 in a section on III-III, viewed in a first operating configuration;
- figure 4 is the section of figure 3, illustrating a second operating configuration.

[0018] With reference to figure 1, numeral 1 denotes a machine for manufacturing filters applicable to tobacco products, embodied in accordance with the present invention.

[0019] Whilst the following specification describes a single track filter maker, the various elements are referable equally to a twin track machine.

[0020] The machine 1 comprises feed means 2 supplying a continuous stream 100 of filter material, a duct 3 along which the continuous stream 100 of filter material is directed and formed into a cylindrical bundle 101 (illustrated partially in figure 3), a nozzle 4 at the end of the duct 3, from which the bundle emerges as a continuous rod 102, a garniture section 5 along which the continuous rod 102 is enveloped in a strip 6 of paper plugwrap material, and means 7 by which the wrapped rod is cut into single filter plugs, also feed means 8, illustrated in figures 2, 3 and 4, supplying a flow of air by which the bundle 101 forming within the duct 3 is subjected to an axial pushing force.

[0021] Referring in particular to figures 2, 3 and 4, the feed means 8 comprise an inlet port 9 admitting the flow of air, associated with a fitting 10 for connection to a compressed air supply line (not illustrated), and an annular passage 11 located between the air inlet 9 and the bore of the duct 3. For the purposes of the present invention, the annular passage affords an air gap of which the flow section is significantly small compared to the length of the selfsame gap as measured along the flow-through

direction.

[0022] In the example of figures 2 to 4, accordingly, the proportions of the annular passage 11 are not to scale, and in particular, the width of the gap admitting the flow of air is augmented in order to illustrate the passage 11 to best advantage.

[0023] Air is conveyed from the inlet port 9 toward the duct 3 in a direction substantially orthogonal, or ideally inclined, relative to the feed direction X followed by the bundle 101 along the duct 3. Also, the air inlet port 9 is not of annular geometry like the passage 11, but located at a single point on the periphery of the duct 3, or in any event a limited number of points (see figures 2 to 4).

[0024] To advantage, the feed means 8 supplying the flow of air comprise equalizing means 12, preferably of a type designed to induce a pressure drop, located between the inlet port 9 and the annular passage 11 and serving to ensure the supply of a uniform flow of air into the passage 11.

[0025] Accordingly, the continuous bundle 101 forming within the duct 3 is invested by a homogeneous flow of air such as will assist its progress along the selfsame duct 3, thus favouring a good stability of production (with filtration properties maintained constant along the full length of the bundle).

[0026] In particular, the equalizing means 12 comprise an expansion chamber 13 located between the inlet port 9 admitting the flow of compressed air, and the annular passage 11.

[0027] The expansion chamber 13 is annular in shape and fully encircles the innermost part of the duct 3, that is to say the tube 14 internally of which the continuous bundle 101 advances.

[0028] The expansion chamber 13 is also connected to a distribution chamber 15, presenting a wall 16, by way of which the flow of air is directed into the annular passage 11.

[0029] More exactly, and as illustrated in figures 2, 3 and 4, the compressed air inlet port 9 communicates directly with the expansion chamber 13, whilst the distribution chamber 15 is located downstream of the expansion chamber 13, presenting an annular configuration and encircling the tube 14 in like manner to the upstream chamber 13.

[0030] According to the invention, the aforementioned wall 16 of the distribution chamber 15, interfacing with the expansion chamber 13 and intercepting the flow of air, presents a plurality of holes 17 by which the flow of air about to enter the annular passage 11 is subjected to a further equalizing action.

[0031] In practice, the holes 17 serve to induce further pressure losses in the flow of air, the effect of which being to equalize the distribution of both the velocity component and the pressure component in the flow directed through the annular passage 11 and onto the continuous bundle 101.

[0032] As discernible in figures 3 and 4, the annular passage 11 is inclined in relation to the feed direction X followed by the bundle 101 along the duct 3, and in particular, inclined at an angle such that the flow of air will be directed as tangentially as possible onto the bundle 101.

[0033] The annular passage 11 is created between two half sections 18 and 19 making up the duct 3.

[0034] In particular, the first half-section 18 of the duct 3 presents a cavity 20 establishing a first segment of the aforementioned tube 14 through which the bundle 101 is directed.

[0035] The cavity 20 is of substantially convergent funnel-like geometry, and thus easily associated with the feed means 2 from which the continuous stream 100 of filter material is received.

[0036] A cavity 20 of the type in question could be embodied as a succession of rectilinear conical duct portions joined suitably one to the next, or alternatively, with a continuous profile of which the geometry appears substantially parabolic or comparable to cubic splines or splines of higher order.

[0037] The second half-section 19 of the duct 3 is associated stably with the first half-section 18 and translatable relative thereto along an axis parallel to the feed direction X followed by the cylindrical bundle 101 forming in the duct, as will be made clearer in due course.

[0038] The first and second half-sections 18 and 19 present respective annular surfaces denoted 21 and 22, breasted one with another and inclined relative to the aforementioned feed direction X of bundle 101.

[0039] The two annular surfaces 21 and 22 in question combine operationally to delimit a main portion of the passage 11.

[0040] More exactly, and as emphasized pictorially in figures 2 to 4 of the drawings, the two inclined annular surfaces 21 and 22 make no contact, but are distanced slightly one from another.

[0041] Advantageously, the distance separating the two inclined annular surfaces 21 and 22 can be adjusted by translating the second half-section 19 relative to the first half-section 18, so as to widen or narrow the flow section afforded by the passage 11: see figure 3, for example, where the flow section of the passage 11 is at minimum, or figure 4, where the flow section is at maximum.

[0042] To enable the aforementioned relative translatory motion between the two half-sections 18 and 19, the second half-section 19 is aligned and associated coaxially with the first half-section 18 by way of suitable coupling means, which in the preferred embodiment illustrated are embodied as respective screw threads 23.

[0043] Thus, rotating the second half-section 19 about an axis coinciding with the feed direction X of the bundle 101, this same second half-section 19 can be distanced from the first half-section 18, and the flow section of the passage 11 widened.

[0044] Importantly, the flow equalizing means 12, and more precisely the expansion chamber 13 and the distribution chamber 15, are associated permanently with

the first half-section 18 and therefore remain stationary during the movement by which the flow section of the annular passage 11 is adjusted.

[0045] Moreover, since only the second half-section 19 of the duct is repositioned to widen or narrow the flow section of the annular passage 11, there is no risk that traces of chemical compounds, utilized to treat the continuous stream 101 of filter material upstream of the duct 3, will be released during the operation of adjusting the passage 11.

[0046] In effect, the second half-section 19 is located downstream of the first half-section 18, as already mentioned, and coupled directly to the nozzle 4 from which the bundle 101 emerges.

[0047] The first half-section 18 presents a sleeve 24 in which the second half-section 19 is insertable and on which an aforementioned coupling thread 23 is formed. The outer surface of the sleeve 24 presents a set screw 25 passing through the sleeve 24 wall, by which the second half-section 19 is engaged and locked in the selected angular position.

[0048] To rotate the second half-section 19 relative to the first half-section 18, accordingly, it suffices to loosen the set screw 25, whereupon the second half-section 19 can be turned one way or the other by means of drive holes 26 located in the end face.

[0049] To advantage, the terminal portion of the annular passage 11 is incorporated directly into a portion of the aforementioned tube 14 coinciding with a substantially cylindrical cavity 27 afforded by the second half-section 19.

[0050] More particularly, the portion of the tube 14 afforded by the second half-section 19 presents a plurality of grooves 28 extending parallel to the feed direction X of the bundle 101, also parallel one with another and distributed circumferentially around the tube 14.

[0051] Accordingly, and to advantage, even in the event that the alignment of the bundle 101 of filter material should be less than perfectly symmetrical on entering the duct 3, and more especially the tube 14, the grooves 28 will ensure that the flow of air continues to invest the entire surface of the bundle 101 and thus cause the material to advance correctly.

[0052] In addition, by favouring an axial orientation of the air flow into the tube 14, the grooves 28 also function actively as flow guides.

[0053] The objects stated at the outset are realized in accordance with the invention.

[0054] In effect, the equalizing means ensure that the pressure and velocity of the air flowing into the annular passage and destined to invest the bundle gathering in the duct will be, to all intents and purposes, uniformly distributed around the entire annular periphery of the passage inlet section.

[0055] In particular, the function of the expansion chamber and the distribution chamber is to handle the flow of air from the inlet port to the annular passage in such a way that it will be rendered uniform and without appreciable variations or imbalances in pressure and velocity.

[0056] In this way, even utilizing just the one inlet port, or at all events a limited number of inlet ports, any asymmetrical distribution of pressure and velocity components in the air flow, considered in relation to the inlet section of the annular passage, is significantly attenuated, so that the flow of air will present substantially the same pressure and velocity characteristics when passing both through the portion of the passage located in close proximity to the inlet port and through the portion of the passage located farthest from the inlet port.

[0057] This ensures that the pressure and velocity of the air flow ultimately investing the rope or bundle of filaments forming along the duct will be substantially uniform around the entire periphery of the bundle, thereby guaranteeing that the bundle advances correctly and maintaining good production stability.

Claims

1. A machine manufacturing filters for tobacco products, comprising

- feed means (2) supplying at least one continuous stream (100) of filter material,
- a duct (3) along which the continuous stream (100) is directed and gathered into a cylindrical rope or bundle (101) of such filter material,
- a nozzle (4) at the end of the duct (3) from which the bundled filter material emerges as a continuous rod (102),
- cutting means (7) by which the rod (102) is divided into discrete filter plugs, and
- feed means (8) supplying a flow of air by which the gathering bundle (101) is forced axially along the duct (3), comprising an inlet port (9) admitting the flow of air and an annular passage (11) located between the inlet port (9) and the bore of the duct (3),

the feed means (8) supplying a flow of air comprising

an expansion chamber (13) which is an annular chamber and that is placed in direct communication with the air flow inlet port (9);

a distribution chamber (15) located between the expansion chamber (13) and the annular passage (11); **characterised in that**

the distribution chamber (15) is annular and comprises a wall (16) furnished with a plurality of holes (17) offered directly to the expansion chamber (13), serving to equalize the flow of air entering the distribution chamber (15).

2. A machine as in claim 1, wherein the distribution chamber (15) is placed in direct communication with the annular passage (11).

3. A machine as in claim 1, wherein the duct (3) comprises a first half-section (18) and a second half-section (19) disposed coaxially with and engaging one another, presenting respective annular surfaces (21, 22) inclined relative to a feed direction (X) followed by the gathering bundle (101) and combining to create at least a part of the annular passage (11).

4. A machine as in claim 3, wherein the second half-section (19) comprises a plurality of grooves (28), presented by a wall of a tube (14) afforded by the duct (3), through and along which the bundle (101) is directed and gathered

5. A machine as in claim 3, wherein the second half-section (19) is capable of movement relative to the first half-section (18) in a direction parallel to the feed direction (X) followed by the bundle (101), to the end of increasing or reducing the flow section afforded by the annular passage (11).

6. A machine as in claim 5, wherein flow equalizing means (12) are embodied integrally with the first half-section (18).

7. A machine as in claim 6, wherein the first half-section (18) comprises a cavity (20) presenting a substantially convergent funnel-like appearance, through and along which the bundle (101) is directed and gathered, directed at one end toward Lhe feed means (2) supplying the filter material, and toward the nozzle (4) at the opposite end.

8. A machine as in claim 7, wherein the cavity (20) appears as succession of rectilinear conical duct portions joined one to the next.

9. A machine as in claim 7, wherein the cavity (20) presents a continuous and streamlined profile of substantially parabolic geometry, or comparable to cubic splines or splines of higher order.

10. A machine as in claim 5, wherein the second half-section (19) is associated movably with the first half-section (18) by way of a screw-threaded coupling (23).

Patentansprüche

1. Maschine zur Herstellung von Filtern für Tabakprodukte, Folgendes beinhaltend:

   - Zufuhrmittel (2) zum Zuführen zumindest eines Endlosstrangs (100) aus Filtermaterial;
   - einen Kanal (3), entlang dem der Endlosstrang (100) geleitet und zu einem zylindrischen Tau oder Bündel (101) aus solchem Filtermaterial zusammengeführt wird;
   - eine Düse (4) an dem Ende des Kanals (3) aus der das gebündelte Filtermaterial als Endlosstange (102) austritt,
   - Schneidmittel (7), durch welche die Stange (102) in einzelne Filterstopfen zerteilt wird;
   - Zufuhrmittel (8) zum Zuführen eines Luftstromes, durch den das zusammenzuführende Bündel (101) axial entlang dem Kanal (3) zwangsgeführt wird, beinhaltend eine Einlassöffnung (9) für den Einlass des Luftstroms und einen ringförmigen Durchgang (11), der zwischen der Einlassöffnung (9) und der Bohrung des Kanals (3) angeordnet ist, wobei die Zufuhrmittel (8) zum Zuführen eines Luftstromes eine Expansionskammer (13) beinhalten, die als ringförmige Kammer ausgebildet ist und in direkte Verbindung mit der Einlassöffnung (9) für den Luftstrom gesetzt ist;
   - eine Verteilungskammer (15), die zwischen der Expansionskammer (13) und dem ringförmigen Durchgang (11) angeordnet ist;
   dadurch gekennzeichnet, dass die Verteilungskammer (15) ringförmig ist und eine Wand (16) beinhaltet, die mit mehreren Löchern (17) versehen ist, die direkt auf die Expansionskammer (13) weisen und zum Ausgleichen des in die Verteilungskammer (15) eintretenden Luftstroms dienen.

2. Maschine nach Anspruch 1, worin die Verteilungskammer (15) in direkte Verbindung mit dem ringförmigen Durchgang (11) gesetzt ist.

3. Maschine nach Anspruch 1, worin der Kanal (3) einen ersten Halbabschnitt (18) und einen zweiten Halbabschnitt (19) beinhaltet, die koaxial zueinander und ineinander eingreifend angeordnet sind und jeweils entsprechende ringförmige Oberflächen (21, 22) aufweisen, die relativ zu einer von dem zusammenzuführenden Bündel (101) verfolgten Vorschubrichtung (X) schräg geneigt sind und zusammenwirken, um zumindest einen Teil des ringförmigen Durchgangs (11) zu bilden.

4. Maschine nach Anspruch 3, worin der zweite Halbabschnitt (19) mehrere Rillen (28) beinhaltet, die an einer vom Kanal (3) aufgewiesenen Wand eines Rohres (14) ausgebildet sind, durch das und entlang dem das Bündel (101) geleitet und zusammengeführt wird.

5. Maschine nach Anspruch 3, worin der zweite Halbabschnitt (19) in der Lage ist, eine Bewegung relativ zu dem ersten Halbabschnitt (18) in einer Richtung parallel zu der von dem Bündel (101) verfolgten Vorschubrichtung (X) auszuführen, um den von dem ringförmigen Durchgang (11) aufgewiesenen Strö-

mungsquerschnitt zu vergrößern oder zu verringern.

6. Maschine nach Anspruch 5, worin Strömungsausgleichsmittel (12) einteilig mit dem ersten Halbabschnitt (18) ausgeführt sind.

7. Maschine nach Anspruch 6, worin der erste Halbabschnitt (18) einen Hohlraum (20) beinhaltet, der eine im Wesentlichen konvergierende trichterartige Gestalt aufweist, durch den und entlang dem das Bündel (101) geleitet und zusammengeführt wird, und der mit einem Ende zu den Zufuhrmitteln (2) für das Zuführen des Filtermaterials und mit dem gegenüberliegenden Ende zu der Düse (4) hin ausgerichtet ist.

8. Maschine nach Anspruch 7, worin der Hohlraum (20) als eine Aufeinanderfolge geradliniger, konischer Kanalabschnitte erscheint, die jeweils einer mit dem nachfolgenden verbunden sind.

9. Maschine nach Anspruch 7, worin der Hohlraum (20) ein kontinuierliches und stromlinienförmiges Profil mit im Wesentlichen parabolischer Geometrie aufweist, beziehungsweise vergleichbar ist mit kubischen Splines oder Splines höheren Grades.

10. Maschine nach Anspruch 5, worin der zweite Halbabschnitt (19) mittels einer Schraubverbindung (23) beweglich mit dem ersten Halbabschnitt (18) verbunden ist.

Revendications

1. Une machine de fabrication de filtres pour produits du tabac, comprenant

- des moyens d'alimentation (2) alimentant au moins un flux continu (100) de matériau filtrant,
- un conduit (3) le long duquel le flux continu (100) est dirigé et rassemblé en un cordon ou faisceau cylindrique (101) dudit matériau filtrant,
- un embout (4) à la fin du conduit (3) d'où le matériau filtrant en faisceau sort sous la forme d'un boudin continu (102),
- des moyens de coupe (7) servant à diviser le boudin (102) en bouts filtres discrets, et
- des moyens d'alimentation (8) alimentant un flux d'air servant à forcer axialement le faisceau (101) rassemblé le long du conduit (3), comprenant un orifice d'entrée (9) pour l'admission du flux d'air et un passage annulaire (11) situé entre l'orifice d'entrée (9) et l'alésage du conduit (3), lesdits moyens (8) d'alimentation d'un flux d'air comprenant une chambre d'expansion (13) qui consiste en une chambre annulaire et qui est mise en communication directe avec l'orifice (9) d'entrée du flux d'air ; une chambre de distribution (15) située entre la chambre d'expansion (13) et le passage annulaire (11) ; ladite machine étant **caractérisée en ce que** la chambre de distribution (15) est annulaire et comprend une paroi (16) dotée d'une pluralité de trous (17) faisant directement face à la chambre d'expansion (13) et servant à égaliser le flux d'air entrant dans la chambre de distribution (15).

2. La machine selon la revendication 1, **caractérisée en ce que** la chambre de distribution (15) est mise en communication directe avec le passage annulaire (11).

3. La machine selon la revendication 1, **caractérisée en ce que** le conduit (3) comprend une première demi-partie (18) et une deuxième demi-partie (19) coaxiales entre elles et en prise réciproque, présentant des surfaces annulaires (21, 22) respectives inclinées par rapport à une direction d'alimentation (X) suivie par le faisceau (101) rassemblé et se combinant pour définir au moins une partie du passage annulaire (11).

4. La machine selon la revendication 3, **caractérisée en ce que** la deuxième demi-partie (19) comprend une pluralité de rainures (28), présentées par une paroi d'un tube (14) présenté par le conduit (3), à travers lequel et le long duquel le faisceau (101) est dirigé et rassemblé.

5. La machine selon la revendication 3, **caractérisée en ce que** la deuxième demi-partie (19) peut se déplacer par rapport à la première demi-partie (18) dans une direction parallèle à la direction d'alimentation (X) suivie par le faisceau (101), afin d'augmenter ou de réduire la section de passage présentée par le passage annulaire (11).

6. La machine selon la revendication 5, **caractérisée en ce que** les moyens (12) d'égalisation du flux sont intégralement réalisés avec la première demi-partie (18).

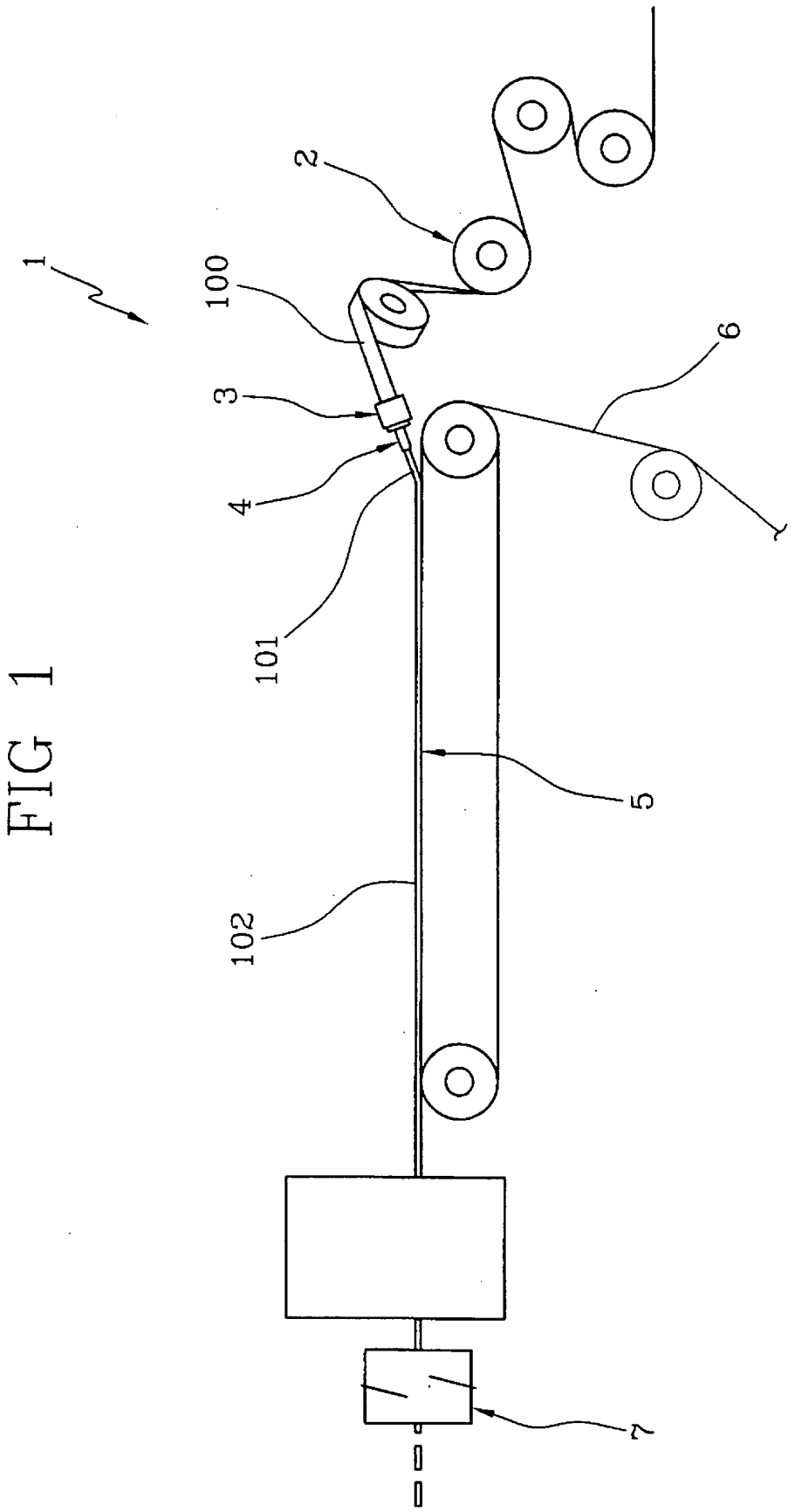
7. La machine selon la revendication 6, **caractérisée en ce que** la première demi-partie (18) comprend une cavité (20) ayant l'aspect d'un entonnoir essentiellement convergent, à travers laquelle et le long de laquelle le faisceau (101) est dirigé et rassemblé, et orientée à une extrémité vers les moyens d'alimentation (2) alimentant le matériau filtrant, et vers l'embout (4) à l'extrémité opposée.

8. La machine selon la revendication 7, **caractérisée en ce que** la cavité (20) apparaît comme une succession de portions de conduit coniques et rectilignes raccordées les unes aux autres.

9. La machine selon la revendication 7, **caractérisée en ce que** la cavité (20) présente un profil continu et aérodynamique de géométrie essentiellement parabolique, ou comparable à des splines cubiques ou des splines d'ordre supérieur.

10. La machine selon la revendication 5, **caractérisée en ce que** la deuxième demi-partie (19) est associée de façon mobile à la première demi-partie (18) par l'intermédiaire d'un accouplement fileté (23).

FIG 1



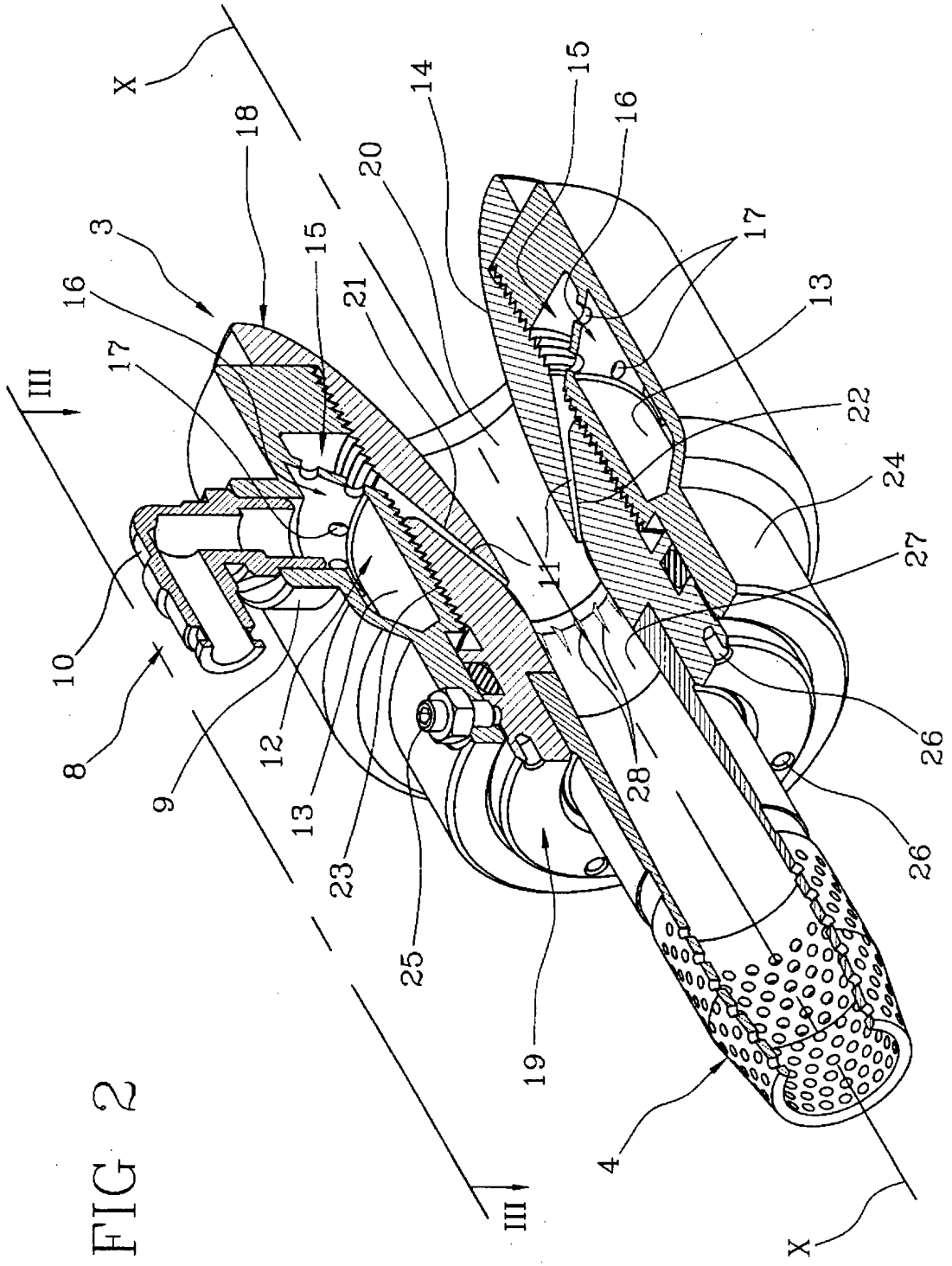

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FIG 2

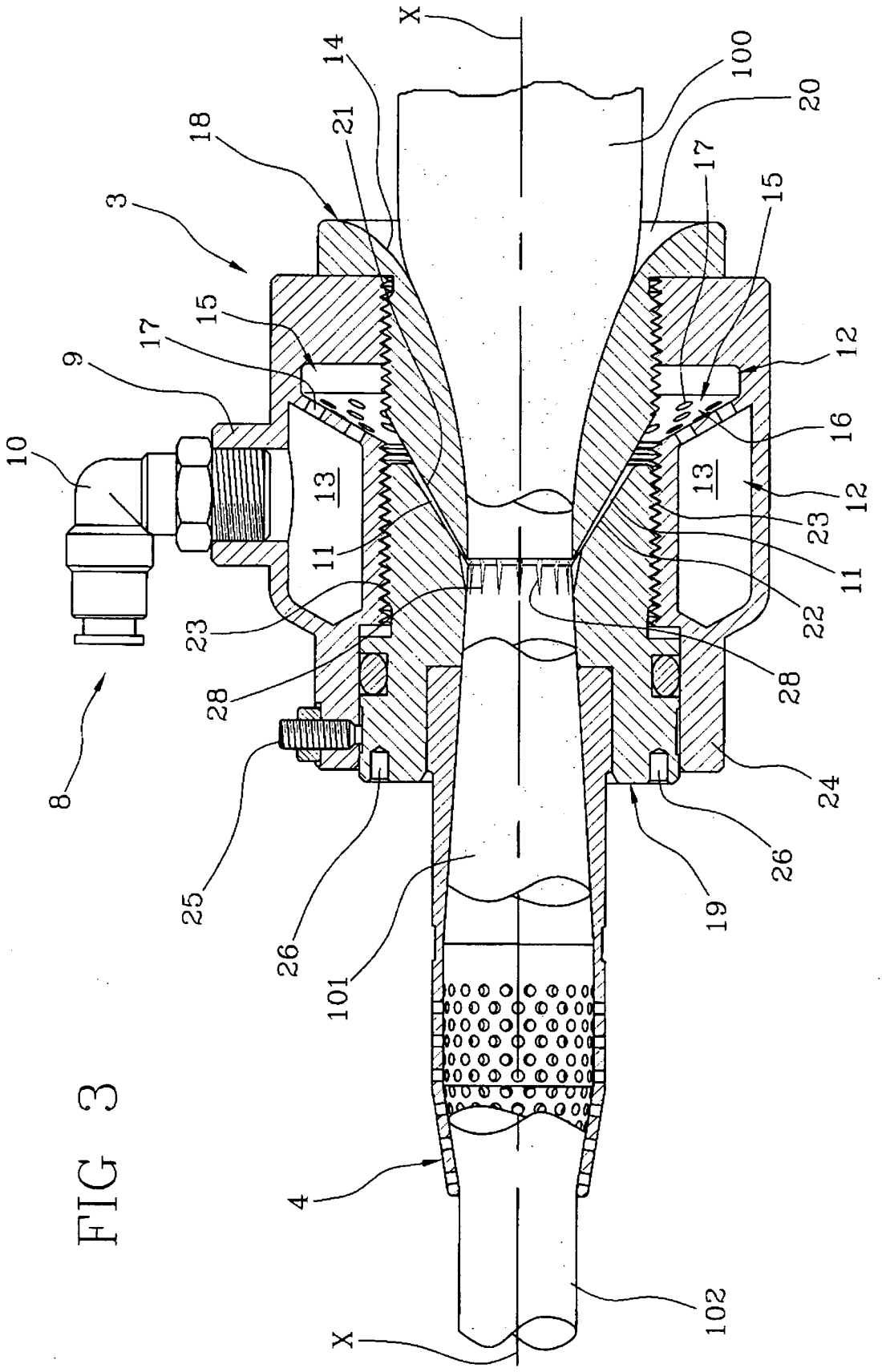
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FIG 3

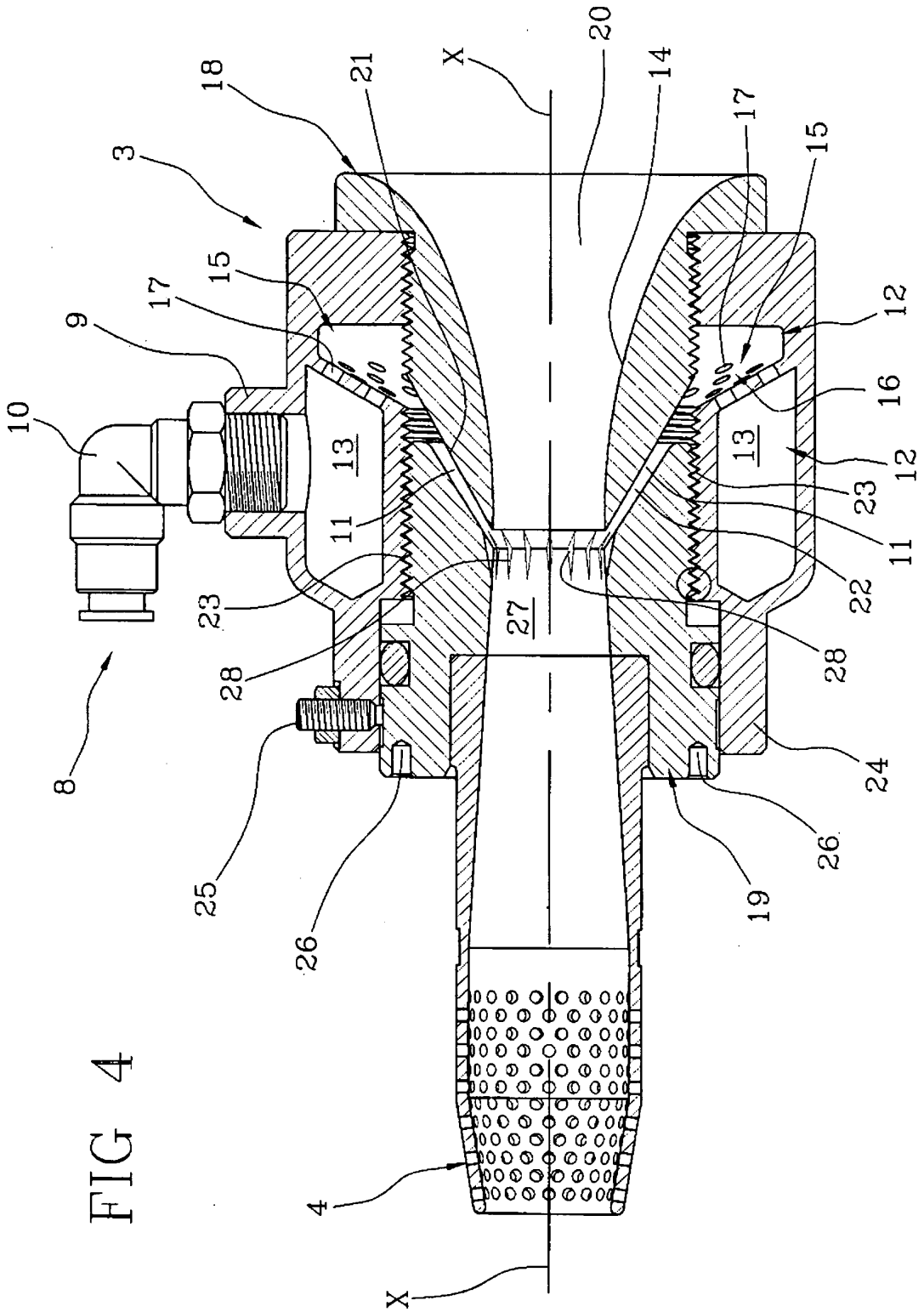
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FIG 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 546519 A **[0009]**
- EP 594054 A **[0009]**