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(54) **FOLDING APPARATUS FOR FOLDING A STRAND OF FILLING MATERIAL PLACED IN CONTINUOUS ROD OF TOBACCO INDUSTRY**

(57) A folding apparatus (4, 4', 4'', 4''') for folding a strip of a filling material (3) placed in a continuous rod (CR) of the tobacco industry, comprising an inner folding element (20, 20', 20'', 20''') having first folding surfaces (22) situated radially around the axis (k) of the inner folding element (20, 20', 20'', 20''') and adapted to crimp the strip of the filling material (3), an outer folding element (21, 21', 21'', 21''') having second folding surfaces (23)

situated radially around the axis (m) of the outer folding element (21, 21', 21'', 21''') and adapted to crimp the strip of the filling material (3), whereas the first folding surfaces (22) situated radially around the axis (k) of the inner folding element (20, 20', 20'', 20''') are arranged between the second folding surfaces (23) situated radially around the axis (m) of the outer folding element (21, 21', 21'', 21''').

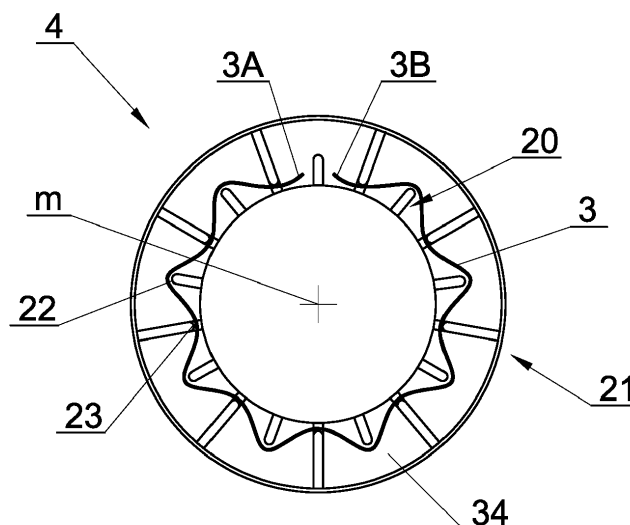


Fig. 5

Description

[0001] The object of the invention is a folding apparatus for folding a strand of filling material placed in a continuous rod of the tobacco industry.

[0002] The invention is used in the tobacco industry to manufacture paper filters.

[0003] In the tobacco industry, a commonly used method of manufacturing cigarette filters consists in forming a continuous rod filled with a filtering material and cutting such rod into individual rods from which either individual mouth-pieces or individual segments are finally cut off and used to manufacture multi-segment filters. The filling material used to manufacture the continuous rod is usually a fibrous material. For many years, paper and acetate fibres have been commonly used, with the filling material usually being in the form of a strand. A problem to be solved by manufacturers of the abovementioned rods is to achieve a cylindrical rod shape. A shape error can be easily seen at the ends of the rod which should be circular, the shape of the end can be oval, and often the ends are irregular, which depends on an uneven arrangement of the filling material inside the rod, which depends on random folding of the material during the feeding of the filling material before the continuous rod is formed. The problem to obtain a circular cross-section is even greater when objects are placed inside the continuous rod. Single objects are commonly used, for example aroma capsules, tubes. Continuous objects are commonly used, for example fibres impregnated with aromatic substances. It is particularly difficult to achieve uniform folding and compaction of the material when the objects are inserted transversely to the direction of movement of the strand of filter material. For each object inserted, a uniform distribution of the filling material around the objects and/or between the objects must be achieved. So the purpose of the present invention is to correctly prepare the strip prior to object insertion.

[0004] In the prior art, devices for folding a paper strip prior to compacting it in the continuous rod production process are known. Such a solution is presented in CN105745069A which discloses an apparatus for processing a continuous strip comprising a crimped structure to be used in the production of a rod-like article, such as a filter element for a smoking article. The apparatus comprises a first roller and a second roller. The first roller and the second roller each contain several circumferentially running cams. Furthermore, the first roller and the second roller are arranged such that the circumferential cam of the first roller and the circumferential cam of the second roller are connected to each other. After conveying a continuous sheet with a crimped structure between the first roller and the second roller, the continuous sheet with the crimped structure may have an overlapping crimped structure and remain continuous, and a corrugated structure extending in the longitudinal direction of the strip.

[0005] An apparatus maintaining a separation between individual strips of crimped paper strip such as in EP3918929A1 is also known. The body of the guiding unit has a funnel-like shape. Inside the ring, separating elements are arranged in a converging channel, with at least one separating element designed to separate at least two strips is situated along the guiding unit. The upper separating element runs from the inlet to the outlet inside the compressing unit and has the shape of an oblong plate whose edges are convergent. The lower separating elements are similar in shape to the upper separating element, i.e. they are oblong and have convergent edges.

[0006] The purpose of the present invention is to develop an apparatus for folding a filling material used in the tobacco industry which will allow filling a continuous rod being manufactured and the rods cut from it so as to obtain a near-circular shape in cross-section, both when the manufactured continuous rod is filled only with the filling material and when separate objects, for example spherical objects such as capsules or oblong objects such as tubes, are placed inside the continuous rod and the individual rods. The expectation to obtain a circular shape in the cross-section of the continuous rod also applies to placing a continuous object, for example a tube, a thin rod, a string or a thread, inside the rod. An additional expectation when placing various objects in the continuous rod is to place the object centrally in the continuous rod.

[0007] The object of the invention is a folding apparatus for folding a strip of filling material placed in a continuous rod of the tobacco industry, comprising an inner folding element having first folding surfaces situated radially around the axis of the inner folding element and adapted to crimp the strip of the filling material, an outer folding element having second folding surfaces situated radially around the axis of the outer folding element and adapted to crimp the strip of the filling material. The first folding surfaces situated radially around the axis of the inner folding element are arranged between the second folding surfaces situated radially around the axis of the outer folding element.

[0008] The apparatus according to the invention is further characterised in that the first folding surfaces are situated convergently with the axis of the inner folding element, from the inlet to the outlet of the folding apparatus, and the second folding surfaces are situated convergently with the axis of the outer folding element, from the inlet to the outlet of the folding apparatus, the axis of the inner folding element being situated coaxially with the axis of the outer folding element.

[0009] The apparatus according to the invention is further characterised in that the first folding surfaces are situated convergently with the axis of the inner folding element, from the inlet to the outlet of the folding apparatus, and the second folding surfaces are situated convergently with the axis of the outer folding element, from the inlet to the outlet of the folding apparatus, the axis of the inner folding element being situated non-coaxially with the axis of the outer folding element.

[0010] The apparatus according to the invention is further characterised in that the distance of the first folding surface from the axis of the first folding element in the direction from the inlet to the outlet increases, reaches a maximum height, and then decreases.

[0011] The apparatus according to the invention is further characterised in that the angle of convergence of the second folding surface with the axis of the second folding element decreases in the direction from the inlet to the outlet.

[0012] The apparatus according to the invention is further characterised in that the first folding surfaces are uniformly arranged around the axis of the inner folding element and/or the second folding surfaces are uniformly arranged around the axis of the outer folding element.

[0013] The apparatus according to the invention is further characterised in that the first folding surfaces are non-uniformly arranged around the axis of the inner folding element and/or the second folding surfaces are non-uniformly arranged around the axis of the outer folding element.

[0014] The apparatus according to the invention is further characterised in that the first folding surfaces and the second folding surfaces are arranged alternately between each other for at least a part of the distance from the inlet to the outlet of the folding apparatus.

[0015] The apparatus according to the invention is further characterised in that the inner folding element comprises first ribs and the first folding surfaces are the ridges of the first ribs and/or the outer folding element comprises second ribs, the second folding surfaces being the ridges of the second ribs.

[0016] The apparatus according to the invention is further characterised in that the thickness of the first ribs and/or the thickness of the second ribs varies in a direction perpendicular and/or parallel to the axis of the first folding element and/or the second folding element, respectively.

[0017] The apparatus according to the invention is further characterised in that the inner folding element comprises an inner bounding surface shaped at least partially conically and/or the outer folding element comprises an outer bounding surface shaped at least partially conically.

[0018] The apparatus according to the invention is further characterised by being provided with a guiding element for guiding a strip of the filling material with an adjustable position in a transverse direction to the axis of the inner folding element or the axis of the outer folding element.

[0019] The apparatus according to the invention is further characterised in that the guiding element is in the form of a rotating element with a horizontal axis of rotation, the axial cross-section of the surface of the rotatable guiding element having an arched or near elliptical shape.

[0020] The apparatus according to the invention is further characterised by comprising a separating element situated above the axis of the inner folding element from the inlet to the outlet of the apparatus.

[0021] The object of the invention is further an apparatus for manufacturing tobacco industry rods, comprising a feeding unit for feeding the filling material, an apparatus for folding the filling material according to one of the abovementioned variants, an apparatus for feeding a wrapping material, a forming unit for forming the continuous rod, a cutting head for cutting the continuous rod into the rods.

[0022] An advantage of the apparatus is that it allows controlled folding of a single paper strip during the compaction of the strip in the folding apparatus. Further advantages of the invention include uniform folding of the filling material and obtaining a uniform density of the filling material in the manufactured rods both having no objects inside and having objects inside. The apparatus makes it possible to adapt the folding of the filling material both for continuous objects with a substantially circular cross-section and for objects with an oval, irregular, polygonal cross-section, in general with any cross-section.

[0023] The object of the invention is shown in more detail in a preferred embodiment in a drawing in which:

Fig. 1a shows a machine for the manufacture of rods with no objects inside,

Fig. 1b shows a machine for the manufacture of rods with individual objects inside,

Fig. 1c shows a machine for the manufacture of rods having oblong objects inside,

Fig. 2a shows an enlarged section of the machine of Fig. 1a with a folding apparatus,

Fig. 2b shows an enlarged section of the machine of Fig. 1b with the folding apparatus,

Fig. 3a shows an inner folding element in the first embodiment in a view from the outlet side of the folding apparatus,

Fig. 3b shows a cross-section through the inner folding element of Fig. 3a,

Fig. 3c	shows a component of the inner folding element in the second embodiment,
Fig. 4a	shows an outer folding element in the first embodiment in a view from the inlet side of the folding apparatus,
5 Fig. 4b	shows an axial section through the outer folding element of Fig. 4a,
Fig. 4c	shows a component of the outer folding element in the second embodiment,
10 Fig. 5	shows the folding apparatus in the first embodiment comprising the inner folding element of Fig. 3a and the outer folding element of Fig. 4a,
Fig. 6	shows the folding apparatus in the second embodiment comprising the inner folding element of Fig. 3c and the outer folding element of Fig. 4c,
15 Fig. 7	shows the inner folding element in the third embodiment in a view from the outlet side of the folding apparatus,
20 Fig. 8	shows the outer folding element in the third embodiment in a view from the inlet side of the folding apparatus,
Fig. 9 and Fig. 10	show the folding apparatus in the third embodiment,
25 Fig. 11a and Fig. 11b	show a section of the machine for the manufacture of rods, including the folding apparatus provided with a fixed guiding element,
Fig. 12a, b, c	show a section of the machine for the manufacture of rods, including the folding apparatus provided with a rotating guiding element,
30 Fig. 13a, b	show a section of the machine for the manufacture of rods, including the folding apparatus in the fourth embodiment for folding a strip of material around a continuous element,
Fig. 14	shows the folding apparatus in the fifth embodiment,
35 Fig. 15	shows the folding apparatus in the sixth embodiment,
Fig. 16	shows the folding apparatus in the seventh embodiment.

[0024] A machine 1 for the manufacture of rods R from a continuous filling material 3 shown in Fig. 1a comprises a feeding unit 2 for feeding a strip of the filling material 3, a folding apparatus 4 for folding the strip of the filling material 3, a forming unit 5 for forming a continuous rod CR and a cutting head 6 for cutting the continuous rod CR of the tobacco industry into individual rods R. The machine 1 shown in Fig. 1a is adapted to manufacture rods filled with the filling material 3 and having no objects inside. Fig. 1b shows a machine built like the machine in Fig. 1a adapted to manufacture the rods R having inside individual objects such as capsules, tubes, etc.. Fig. 1c shows a machine built like the machine in Fig. 1a adapted to manufacture the rods R having oblong objects inside with the length of the rod R cut from a continuous object.

[0025] The feeding unit 2 comprises an unwinding unit 7 in which a bobbin 8 of the strip of the filling material 3 is located, and a tensioning unit 9 for maintaining a constant tension of the filling material 3. The forming unit 5 comprises a formatting bar 10, an adhesive apparatus 11 and a wrapping unit 12. Between the feeding unit 2 and the folding apparatus 4, there may be arranged a crimping unit 13 which is used to crimp or longitudinally cut the strip of the material 3. The filling material 3 is a material selected from a group comprising paper, acetate, or any other fibrous material. The wrapping material 14 is supplied from a supplying unit 15 and is typically in the form of a paper tape unwound from a bobbin.

[0026] The strip of the material 3 is unwound from the bobbin 8, passes through the tensioning unit 9 and is fed to the folding apparatus 4 where the filling material 3 is folded and compacted. Before feeding the strip of the filling material 3 to the folding apparatus 4, it may be additionally crimped or cut in the crimping unit 13. The folding of the filling material 3 is carried out by means of inner folding surfaces and outer folding surfaces of folding elements, as is discussed below in this description. The folded and compacted strip of the material 3 is formed into a cylindrical shape and is wrapped with the wrapping material 14 so as to obtain a continuous rod CR, whereas the adhesive from the adhesive apparatus

11 is fed to glue the wrapping material. The continuous rod **CR** is cut into the individual rods **R** by means of the cutting head **6**. The produced rods **R** are used to manufacture tobacco industry articles, and are cut into individual mouthpieces or segments for multi-segment filters.

[0027] The folding apparatus **4** for folding the strip of the filling material **3** shown in simplified terms in **Fig. 2a** comprises an inner folding element **20** and an outer folding element **21**. The inner folding element **20** shown with a dashed line is situated inside the outer folding element **21**. The filling material moves in the direction **T**. The inlet of the folding apparatus **4** is marked as **40**, the outlet of the folding apparatus **4** is marked as **41**. The folding apparatus shown in **Fig. 2b** is a fragment of the machine shown in **Fig. 1b** adapted to manufacture rods provided with individual objects. In the embodiment shown, downstream of the folding apparatus **4**, there is an inserting unit **35** for placing capsules inside the formed continuous rod **CR**. Such unit may comprise, for example, an inserting wheel **44** (**Fig. 11a**) or another inserting element.

[0028] The inner folding element **20** in the first embodiment shown in **Fig. 3a** and **Fig. 3b** has first folding surfaces **22** arranged around the axis **k** of the inner folding element **20**. In the shown embodiment of the folding apparatus **4**, the inner folding element **20** comprises first ribs **24**, the first folding surface **22** being the ridge of the first rib **24**. The first folding surfaces **22** are arranged radially to the axis **k**, the first folding surfaces **22** being arranged circularly around an inner bounding surface **26**, which means that the folding surfaces are arranged on the bounding surface **26** at angular intervals on radii extending substantially from the axis **k** of the inner folding element **20**, the inner bounding surface **26** being shaped at least partially as a cone. The inner bounding surface **26** may be in the form of a cone fragment, i.e. it may be shaped partly as a cone, it may comprise flat fragments or surfaces having irregular or regular curvatures. **Fig. 3c** shows an inner folding element **20'** having the first folding surfaces **22** as in **Fig. 3b**, the inner folding element **20'** comprising profiled bars **28**, the bar **28** being shaped similar to the ridge of the first rib **24**. The bars **28** are fixed on rings **29** and **30**. The outer folding element **21** is shown in the first embodiment in **Fig. 4a** and **Fig. 4b** and has second folding surfaces **23** arranged around the axis **m** of the outer folding element **21**, the second folding surfaces **23** being positioned radially to the axis **m**. The outer folding element **21** comprises second ribs **25**, the second folding surface **23** being the ridge of the second ribs **25**. The second folding surfaces **23** are arranged circularly inside the outer bounding surface **27**, whereas the outer bounding surface **27** may be partly shaped as a cone. The outer bounding surface **27** may be in the form of a cone fragment, i.e. it may be shaped partly as a cone, it may comprise flat fragments or surfaces having irregular or regular curvatures. **Fig. 4c** shows an outer folding element **21'** having the second folding surfaces **23** as in **Fig. 4b**, the element **21'** comprising profiled bars **31**, the bar **31** being shaped similar to the ridge of the second rib **25**. The bars **31** are fixed on rings **32** and **33**.

[0029] The folding apparatus **4** in the first embodiment shown in **Fig. 5** comprises the inner folding element **20** of **Fig. 3a** and the outer folding element **21** of **Fig. 4a** positioned relative to each other so that the axis **k** of the inner folding element **20** and the axis **m** of the outer folding element **21** coincide. The first folding surface **22** is situated between the second folding surfaces **23**, the second folding surface **23** is situated between the first folding surfaces **22**. The first folding surfaces **22** and the second folding surfaces **23** are arranged circularly around the axes **k**, **m**, respectively. In this embodiment, both the first folding surfaces **22** and the second folding surfaces **23** are arranged uniformly around the convergent axes **k**, **m**. It is possible to position the axes **k** and **m** at a small angle or non-coaxially parallel to each other. **Fig. 6** shows a folding apparatus **4'** in the second embodiment. The folding apparatus **4'** comprises the inner folding element **20'** shown in **Fig. 3c** and the outer folding element **21'** shown in **Fig. 4c**. The first folding surfaces **22** and the second folding surfaces **23** are arranged similar to the first embodiment. The first folding surfaces **22** and the second folding surfaces **23** alternate between each other for at least a part of the distance from the inlet **40** to the outlet **41** of the folding apparatus **4**, **4'**.

[0030] The first folding surfaces **22**, the second folding surfaces **23**, the inner bounding surface **26** and the outer bounding surface **27** form a folding channel **34**. In the embodiment shown in **Fig. 5**, the strip of the filling material **3** moves in the folding channel **34** and is uniformly folded. The folding of the filling material **3** in **Fig. 5** and in the other figures is shown in simplified terms. The non-coaxiality or non-parallelism of the axes **k** and **m** of the folding elements **20** and **21** can be used to non-uniformly fold the strip of the filling material **3** and to alter the degree of compaction of the material around the axes **k**, **m** in a controlled manner.

[0031] The inner folding element **20** and the outer folding element **21**, shown generally in **Figs. 2a, 2b**, are arranged so that the inlet side **20A** (**Fig. 3b**) of the inner folding element **20** is on the inlet side **40** of the folding apparatus **4** (**Fig. 2**). The inlet side **21A** (**Fig. 4b**) of the outer folding element **21** is also situated on the inlet side **40** of the folding apparatus **4**. The outlet side **20B, 21B** of the inner folding element **20** and the outer folding element **21**, respectively, are situated on the outlet side **41** of the folding apparatus **4**. The first folding surface **22** is situated convergently with the axis **k** of the inner folding element, from the inlet **40** to the outlet **41** of the folding apparatus **4**. The second folding surface **23** is situated convergently with the axis **m** of the outer folding element **21**, from the inlet **40** to the outlet **41** of the folding apparatus **4**, i.e. in the direction of movement **T** of the strip of the filling material **3**. The height **h1** of the first rib **24**, measured from the inner bounding surface **26**, may be variable. The height **h1** of the first rib **24** decreases from the inlet **40** to the outlet **41** of the folding apparatus **4**, the first rib **24** being rounded on the side of the inlet **40**. The distance **d** of a point on the first folding surface **22** from the axis **k** varies so that from **d1** at the inlet **40** the distance **d** increases from

d1 to **d2** and then decreases from **d2** via **d3** to **d4** at the outlet **41**. The height **h2** of the second rib **25**, measured from the outer bounding surface **27**, may be variable. The height **h2** of the second rib **25** varies from the inlet **40** to the outlet **41**, namely first increasing and then decreasing, the second rib **25** being rounded on the side of the inlet **40**. Increasing the height of the ribs allows the filling material **3** to be crimped to a greater extent, whereas the folding accomplished in such a way allows obtaining a near circular shape in the cross-section of the continuous rod **CR**. Similarly, increasing the number of ribs allows folding the filling material to a greater extent and obtaining a near-circular shape in the cross-section of the continuous rod **CR**.

[0032] The strip of the filling material **3** is supplied to the folding apparatus **4** in a flat form and is re-formed from a flat configuration to a substantially circular configuration around the axes **k**, **m** in the folding channel **34** as shown in **Fig. 5**, the strip of the filling material **3** being situated between the first folding surfaces **22** and the second folding surfaces **23**. The inner folding surfaces **22** are arranged uniformly around the axis **k** and the outer folding surfaces **23** are arranged uniformly around the axis **m**, in this case around the same axis.

[0033] In the embodiment shown in **Fig. 7**, an inner folding element **20''** is provided with the first ribs **24'** which are non-uniformly arranged around the axis **k** of the inner folding element **20''**. The thickness **g** of the first rib **24** is variable in the direction of movement **T** of the filling material **3**, i.e. in a direction substantially parallel to the axis **k**. The thickness **g** on the side of the inlet **40** is greater than the thickness **g'** on the side of the outlet **41**. Furthermore, the thickness **g** of the first rib **24** may be variable in a direction transverse to the direction of movement **T** of the filling material **3**, i.e. in a direction substantially perpendicular to the axis **k**. The thickness **g''** (shown in **Fig. 9**) at the inner bounding surface **26** is greater than the thickness **g** on the ridge of the rib **24**. **Fig. 8** shows an outer folding element **21''** provided with the second ribs **25** which have a variable thickness **f**. The thickness **f** of the second rib **25** is variable in the direction of movement **T** of the filling material **3**, i.e. in a direction substantially parallel to the axis **m**. The thickness **f** on the side of the inlet **40** is greater than the thickness **f'** on the side of the outlet **41**. Furthermore, the thickness **f** of the second rib **25** is variable in a direction transverse to the direction of movement **T** of the filling material **3**, i.e. in a direction substantially perpendicular to the axis **m**. The thickness **f** at the outer bounding surface **27** is greater than the thickness **f'** on the side of the axis **m**. The first ribs **24** are non-uniformly arranged around the axis **k**. The second ribs **25** are also non-uniformly arranged around the axis **m**. The arrangement of the second ribs **25** of the outer folding element **21''** is aligned with the arrangement of the first ribs **24** of the inner folding element **20''** of **Fig. 7**. The inner folding element **20''** and the outer folding element **21''** are arranged together in **Fig. 9**, with the axis **k** and the axis **m** coinciding, while in **Fig. 10** the inner folding element **20''** and the outer folding element **21''** are arranged together so that the axis **k** and the axis **m** are not coaxial, the axis **k** of the inner folding element **20''** being situated above the axis **m** of the outer folding element **21''**. By arranging the elements **20''** and **21''** in this way, a higher compaction in the upper part of the folding channel **34** is achieved due to increased folding of the filling material **3**. When the axis **k** of the inner folding element **20''** is situated below the axis **m** of the outer folding element **21''**, a higher compaction in the lower part of the folding channel **34** is achieved. By adjusting the position of the inner folding element **20''** relative to the outer folding element **21''**, a gradual variation in the compaction of the filling material **3** in the manufactured continuous rod **CR** can be achieved. The uniformly arranged folding of the filling material **3** makes it possible to obtain a central position of the objects inside the continuous rod **CR**.

[0034] In **Fig. 11a**, in a cross-section along the axis **r** of a forming channel **42**, there can be seen a separating element **43** which can also be seen in **Fig. 9** and **Fig. 10**. The separating element **43** is situated above the axis or tangentially to the axis **k** of the inner folding element **20** from the inlet **40** into the forming channel **42**. The separating element **43** is in the form of a plate of decreasing width, i.e. of a width close to the radius of the outer bounding surface **27** at the inlet **40** and further of decreasing width to the outlet **41** and further into the forming channel **42**. Further in the direction of movement **T** of the strip of the material **3**, the separating element **43** reaches the inserting wheel **44** for inserting individual objects **45**, for example capsules, into the strip of the filling material **3**. The separating element **43** separates the edges **3A**, **3B** the strip of the filling material **3** both in the folding apparatus **4** and in the forming channel **42**. The use of the separating element **43** facilitates the insertion of the capsules **45** by separating the edges **3A**, **3B**.

[0035] The folding apparatus **4** can be provided with a guiding element along which the filling material **3** is conveyed before feeding it for folding. **Fig. 11a** and **Fig. 11b** show a non-rotational guiding element **46** which is in the form of an arc. The non-rotational guiding element **46** has an adjustable position and is adapted to alter its position in a direction transverse to the axis **k** of the inner folding element **20** or the axis **m** of the outer folding element **21**. The non-rotational guiding element **46** is mounted on a bracket **47** which is provided with an adjustment in the direction **S**, i.e. in a direction transverse to the axis **k** or **m** of the folding elements **20**, **21**. **Fig. 12a** and **Fig. 12b** show a rotational guiding element **48** with a horizontal axis of rotation **p**, the surface **48A** of the rotational guiding element **48** having an arched or near elliptical shape in cross-section. The rotational guiding element **48** is also provided with an adjustment in the direction **S**. An alteration in the position of the non-rotational guiding element **46** or the rotational guiding element **48** has the effect of varying the degree of compaction of the filling material **3** in the continuous rod **CR**, a movement of the guiding element **46**, **48** downwards causes an increase in compaction in the lower part of the folding apparatus, i.e. in the area of the edges **3A**, **3B**. In the embodiment of **Fig. 12a**, an inserting wheel **49** for placing the tubes **50** in the continuous rod **CR** is shown. As in the case of the capsules **45**, the separating element **43** facilitates the insertion of the tubes **50**

between the fibres of the filling material 3.

[0036] The folding apparatus 4" shown in Fig. 13a is a fragment of the machine shown in Fig. 1c, adapted to manufacture the rods R provided with oblong objects. In the embodiment shown, upstream of the folding apparatus 4, there is a supplying unit 36 for supplying the continuous object 50 into the continuous rod CR being formed. The continuous object 50 may have a transverse circular, oval, polygonal, multi-armed or any other cross-section. In the embodiment shown, the continuous object 50 is in the form of a tube. Fig. 13b shows an embodiment of the folding apparatus 4" adapted to fold the filling material 3 around the continuous object 50 fed centrally through by the inner folding element 20". The continuous object 50 is fed through an opening 51 in the inner folding element 20". The folding apparatus 4" can be adapted to any other cross-section of the continuous object 50.

[0037] Fig. 14 shows an embodiment wherein the first ribs 24' and the second ribs 25' have an increased height at the side of the inlet 40 relative to the first ribs 24 and the second ribs 25 in the previous embodiments. The first folding surfaces 22 and the second folding surfaces 23 are shaped in any of the ways discussed above. The first rib 24' may be provided with a slidably mounted foot 53 and is adapted to an alteration in position according to the direction U around the axis k. The second rib 25' may be provided with a slidably mounted foot 54 and is adapted to an alteration in position according to the direction U around the axis m. The variation in position of the first folding surfaces 22 and/or the second folding surfaces 23 around the axis k of the inner folding element 20 or the axis m of the outer folding element 21 may be used in any of the embodiments discussed above. Thus, it is possible to shape the folding channel 34 variously and in any manner and to adapt the folding of the filling material to the production requirements.

[0038] Fig. 15 shows an embodiment wherein the folding apparatus is provided with a single first folding surface 22 and two second folding surfaces 23, the first folding surface 22 being positioned between the two second folding surfaces 23. An embodiment wherein a single second folding surface 23 is situated between the two first folding surfaces 22 is also possible.

[0039] Fig. 16 shows a folding apparatus 4''' comprising the inner folding element 20''' and the outer folding element 21'''. The first folding surfaces 22 of the inner folding element 20''' and the second folding surfaces 23 of the outer folding element 21''' are arranged such that the folding channel 34 has a width that varies over a small range or is substantially constant. The position of the first folding surfaces 22 and the second folding surfaces 23, and thus of the folding channel 34, may be variable. The position of the first folding surfaces 22 is defined by the distance e from the axis k. The distance e from the axis k in the lower part of the folding apparatus 4''' is greater than the distance e' in the upper part of the folding apparatus 4'''. In the embodiment shown, the distance e of the successive inner folding surfaces 22 gradually decreases to e'. The distance e may be constant for all first folding surfaces 22. The position of the second folding surfaces 23 is defined by the distance c from the axis m. The distance c from the axis m in the lower part of the folding apparatus 4''' is greater than the distance c' in the upper part of the folding apparatus 4'''. In the embodiment shown, the distance c of the successive inner folding surfaces 23 gradually decreases to c'. The distance c can be constant for all second folding surfaces 23. The folding apparatus 4''' can be used for the low-strength filling material 3.

List of designations		41	outlet of folding apparatus
1	rod manufacturing machine	42	forming channel
2	feeding unit	43	separating element
3	filling material	44	object/capsule inserting wheel
3A, 3B	edges of strip of filling material	45	inserted objects, capsules
4, 4', 4'', 4''', 4''''	folding apparatus	46	non-rotational guiding element
5	forming unit	47	bracket of guiding element
6	cutting head	48	rotational guiding element
7	unwinding unit	49	tube inserting wheel
8	bobbin of material strip	50	inserted continuous objects, tubes
9	tensioning unit	51	hole in inner folding element 20'''
10	format bar	53	foot of first rib 24'
11	adhesive apparatus	54	foot of second rib 25'
12	wrapping unit		
13	crimping unit	d	distance of first folding surface from axis k
14	wrapping material	e	distance of first folding surface from axis k
15	supplying unit	c	distance of second folding surface from axis m
20, 20', 20'', 20'''	inner folding element		
20A	inlet side of inner folding element	h1	height of first rib
20B	outlet side of inner folding element	h2	height of second rib

(continued)

	21, 21', 21'', 21'''	outer folding element	g	thickness of first rib on inlet side
	21A	inlet side of outer folding element	g'	thickness of first rib on outlet side
5	21B	outlet side of outer folding element	g''	thickness of first rib at inner bounding surface
			f	thickness of second rib
	22	first folding surfaces	f'	thickness of second rib on inlet side
	23	second folding surfaces	f''	thickness of second rib on outlet side
10	24, 24'	first ribs		
	25, 25'	second ribs	k	axis of inner folding element
	26	inner bounding surface	m	axis of outer folding element
	27	outer bounding surface	p	horizontal axis of rotation of rotational guiding element
	28	profiled bars		
15	29, 30	fastening rings	r	axis of forming channel
	31	profiled bars		
	32, 33	fastening rings	S	direction of guiding element adjustment
	34	folding channel	T	direction of movement of filling material
	35	inserting unit	U	direction of movement of ribs
20	36	supplying unit	CR	continuous rod
	40	inlet of folding apparatus	R	rod

Claims

1. A folding apparatus (4, 4', 4'', 4''') for folding a strip of filling material (3) placed in a continuous rod (CR) of the tobacco industry, comprising

an inner folding element (20, 20', 20'', 20''') having first folding surfaces (22) situated radially around the axis (k) of the inner folding element (20, 20', 20'', 20''') adapted to fold the strip of the filling material (3),
an outer folding element (21, 21', 21'', 21''') having second folding surfaces (23) situated radially around the axis (m) of the outer folding element (21) adapted to fold the strip of the filling material (3),

whereas the first folding surfaces (22) situated radially around the axis (k) of the inner folding element (20, 20', 20'', 20''') are arranged between the second folding surfaces (23) situated radially around the axis (m) of the outer folding element (21, 21', 21'', 20''').

2. The apparatus as in claim 1, **characterised in that** the first folding surfaces (22) are situated convergently with the axis (k) of the inner folding element (20, 20', 20'', 20'''), from the inlet (40) to the outlet (41) of the folding apparatus (4, 4', 4'', 4''', 4'''''), and the second folding surfaces (23) are situated convergently with the axis (m) of the outer folding element (21, 21', 21'', 21'''), from the inlet (40) to the outlet (41) of the folding apparatus (4, 4', 4'', 4''', 4'''''), the axis (k) of the inner folding element (20, 20', 20'', 20''') being situated coaxially with the axis (m) of the outer folding element (21, 21', 21'', 21''').

3. The apparatus as in claim 1, **characterised in that** the first folding surfaces (22) are situated convergently with the axis (k) of the inner folding element (20, 20', 20'', 20'''), from the inlet (40) to the outlet (41) of the folding apparatus (4, 4', 4'', 4''', 4'''''), and the second folding surfaces (23) are situated convergently with the axis (m) of the outer folding element (21, 21', 21'', 21'''), from the inlet (40) to the outlet (41) of the folding apparatus (4, 4', 4'', 4''', 4'''''), the axis (k) of the inner folding element (20, 20', 20'', 20''') being arranged non-coaxially with the axis (m) of the outer folding element (21, 21', 21'', 21''').

4. The apparatus as in claims 1 to 3, **characterised in that** the distance (d) of the first folding surface (22) from the axis (k) of the first folding element (20, 20', 20'', 20''') in the direction from the inlet (40) to the outlet (41) increases, reaches a maximum height, and then decreases.

5. The apparatus as in any of the claims 1 to 4, **characterised in that** the angle of convergence (a) of the second folding surface (23) with the axis (m) of the second folding element (21, 21', 21'', 21''') decreases in the direction

from the inlet (40) to the outlet (41).

6. The apparatus as in any of the claims 1 to 5, **characterised in that** the first folding surfaces (22) are uniformly arranged around the axis (k) of the inner folding element (20, 20', 20", 20''') and/or the second folding surfaces (23) are uniformly arranged around the axis (m) of the outer folding element (21, 21', 21'', 21''').
7. The apparatus as in any of the claims 1 to 5, **characterised in that** the first folding surfaces (22) are non-uniformly arranged around the axis (k) of the inner folding element (20, 20', 20", 20''') and/or the second folding surfaces (23) are non-uniformly arranged around the axis (m) of the outer folding element (21, 21', 21'', 21''').
8. The apparatus as in any of the claims 1 to 7, **characterised in that** the first folding surfaces (22) and the second folding surfaces (23) are arranged alternately between each other for at least a part of the distance from the inlet (40) to the outlet (41) of the folding apparatus (4, 4', 4'', 4''', 4'''').
9. The apparatus as in any of the claims 1 to 8, **characterised in that** the inner folding element (20, 20', 20", 20''') comprises first ribs (24, 24') and the first folding surfaces (22) are the ridges of the first ribs (24, 24') and/or the outer folding element (21, 21', 21'', 21''') comprises second ribs (25, 25') and the second folding surfaces (23) are the ridges of the second ribs (25, 25').
10. The apparatus as in any of the claims 1 to 9, **characterised in that** the thickness (g) of the first ribs (24, 24') and/or the thickness (f) of the second ribs (25, 25') varies in a direction perpendicular and/or parallel to the axis (k, m) of the inner folding element (20, 20', 20", 20''') and/or the outer folding element (21, 21', 21'', 21'''), respectively.
11. The apparatus as in any of the claims 1 to 10, **characterised in that** the inner folding element (20, 20', 20", 20''') comprises an inner bounding surface (26) shaped at least partially conically and/or the outer folding element (21, 21', 21'', 21''') comprises an outer bounding surface (27) shaped at least partially conically.
12. The apparatus as in any of the claims 1 to 11, **characterised by** being provided with a guiding element (46, 48) for guiding a strip of the filling material (3) with an adjustable position in a transverse direction to the axis (k) of the inner folding element (20, 20', 20", 20''') or the axis (m) of the outer folding element (21, 21', 21'', 21''').
13. The apparatus as in any of the claims 1 to 11, **characterised in that** the guiding element (48) is in the form of a rotating element with a horizontal axis of rotation (p), the axial cross-section of the surface (48A) of the rotatable guiding element (48) having an arched or near elliptical shape.
14. The apparatus as in any of the claims 1 to 13, **characterised by** comprising a separating element (43) situated above the axis (k) of the inner folding element (20, 20', 20", 20''') from the inlet (40) to the outlet (41) of the folding apparatus (4, 4', 4'', 4''', 4'''').
15. The apparatus for manufacturing tobacco industry rods, comprising a feeding unit (2) for feeding the filling material (3), an apparatus (4, 4', 4'', 4''', 4''') for folding the filling material (3) according to any of the claims 1 to 14, an apparatus (15) for feeding a wrapping material (14), a forming unit (5) for forming the continuous rod (CR), a cutting head (6) for cutting the continuous rod (CR) into the rods (R).

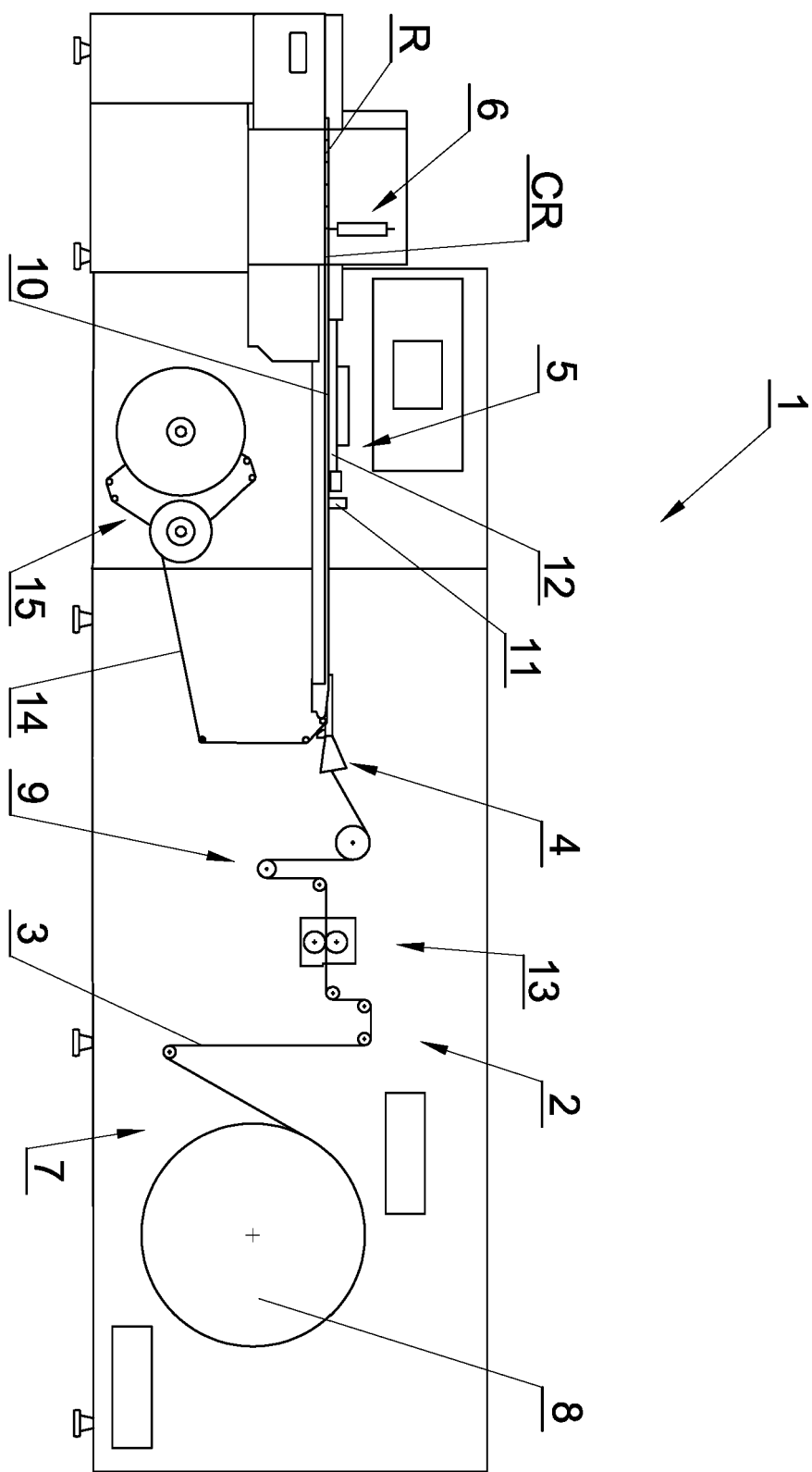


Fig. 1a

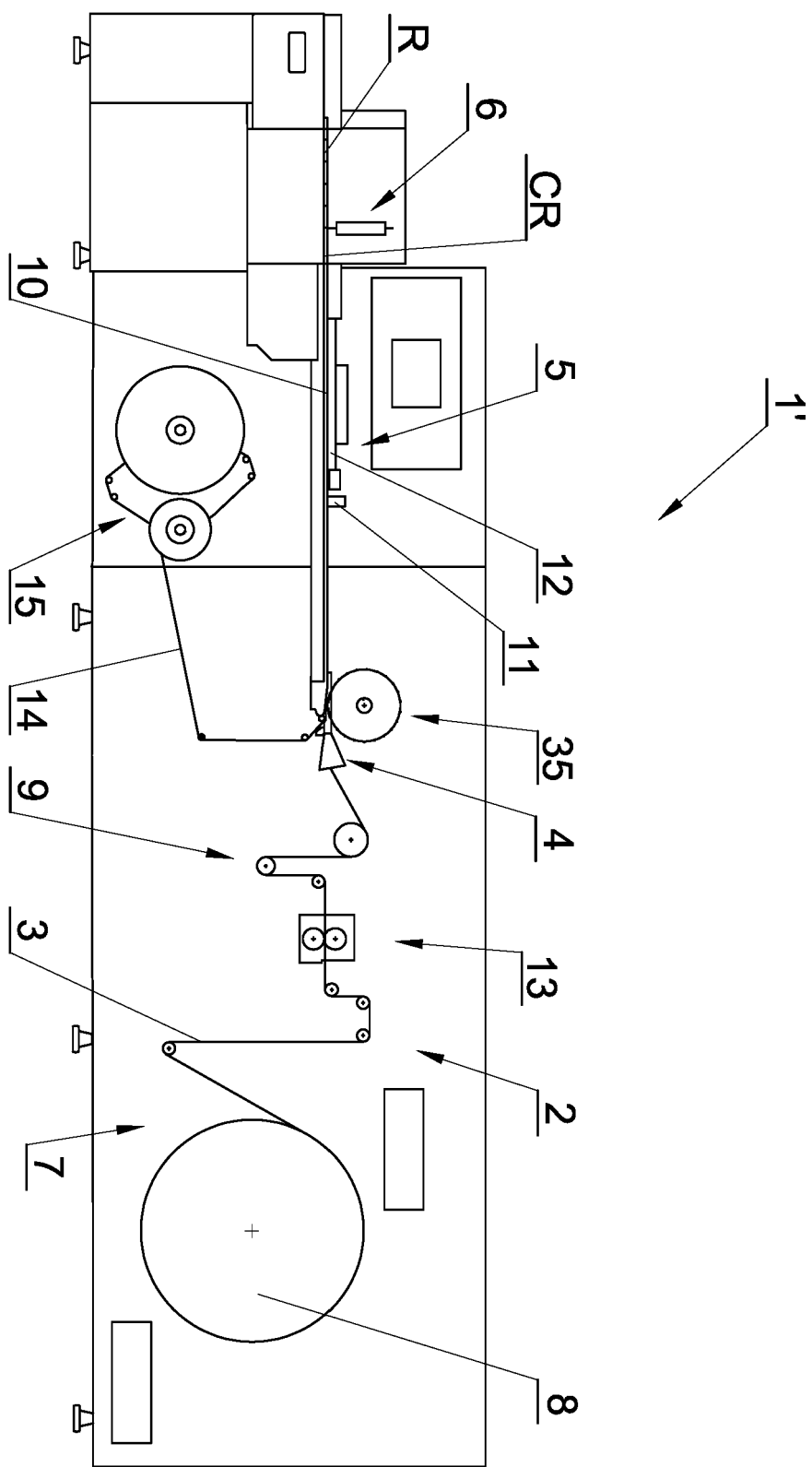


Fig. 1b

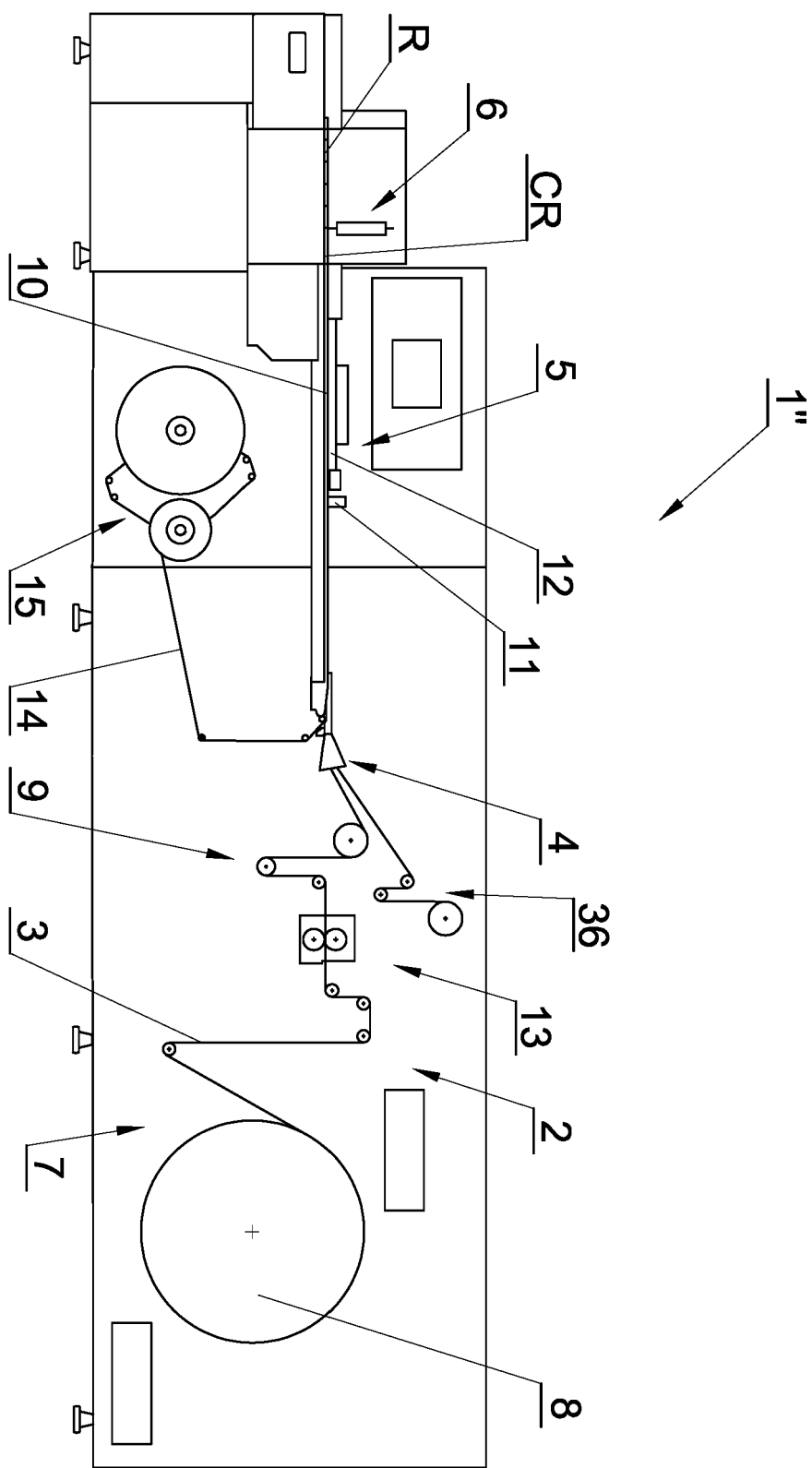


Fig. 1c

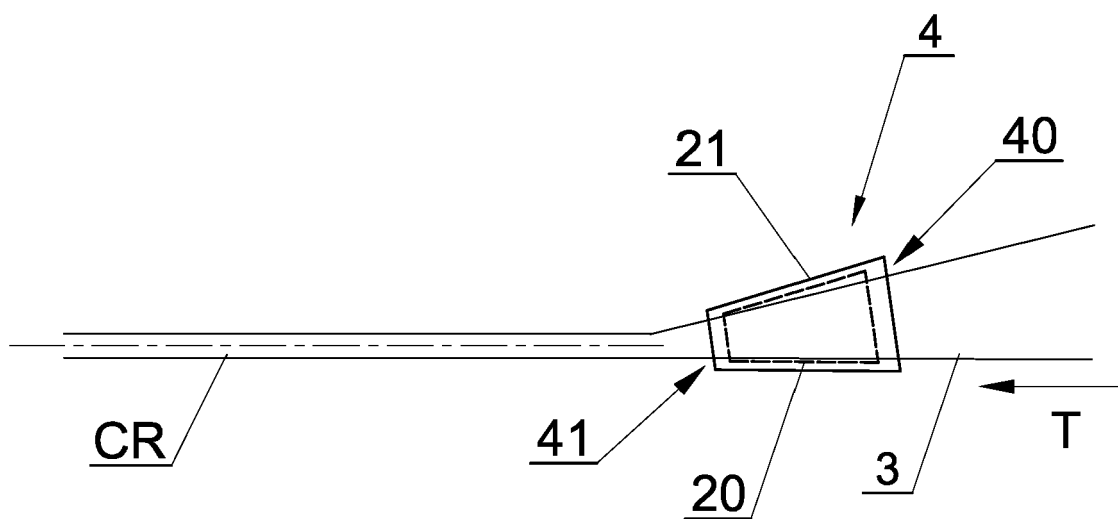


Fig. 2a

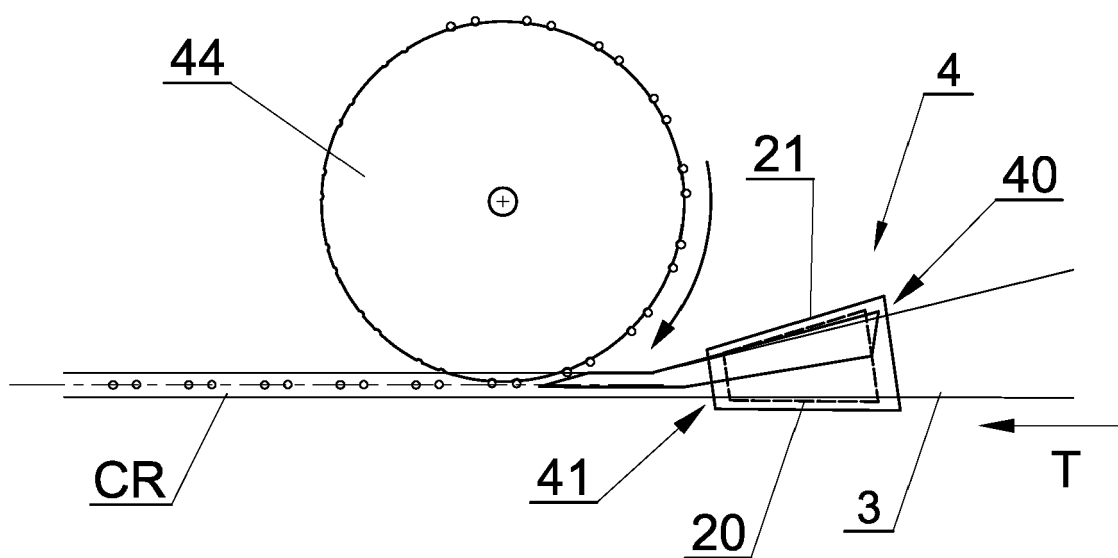


Fig. 2b

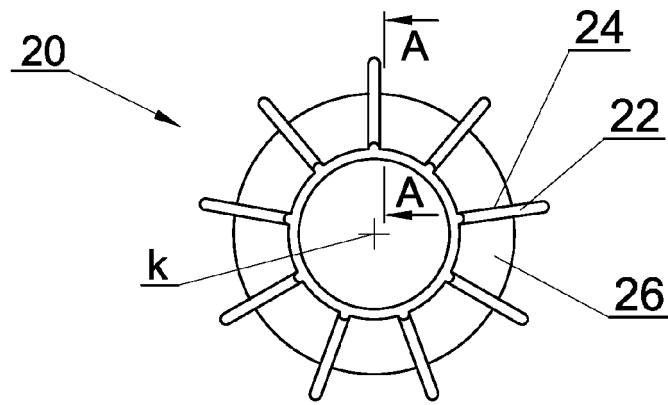


Fig. 3a

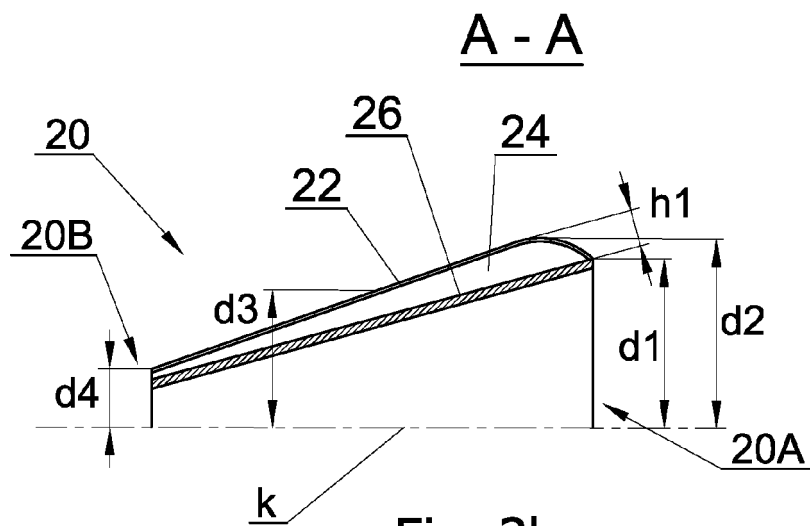


Fig. 3b

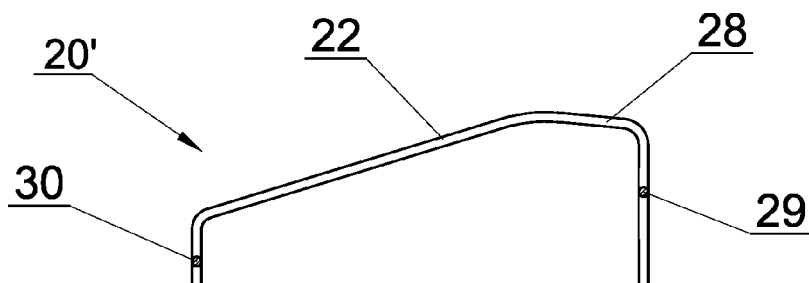


Fig. 3c

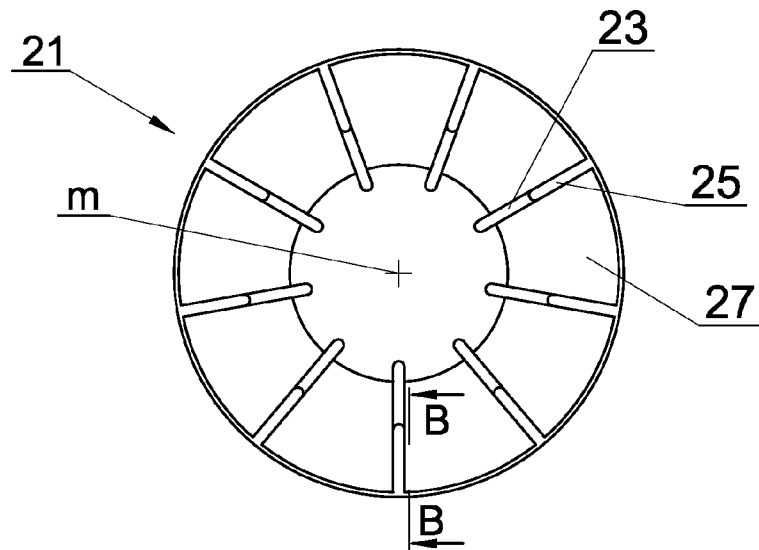


Fig. 4a

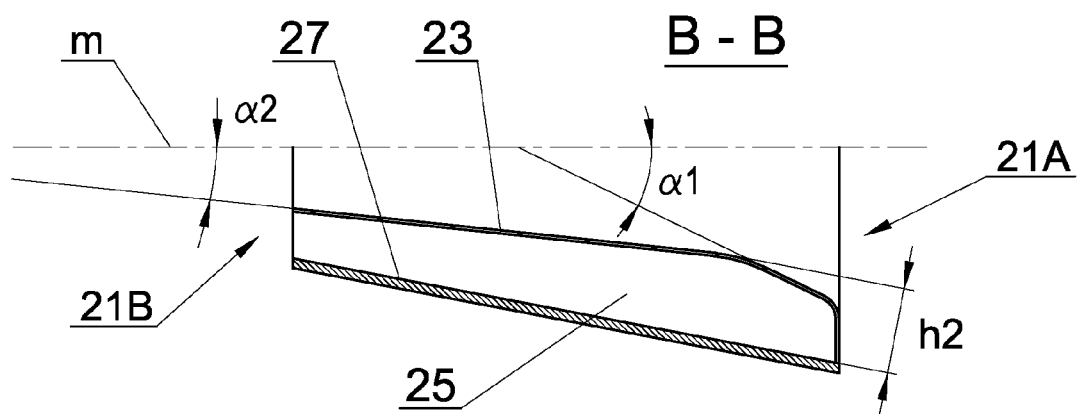


Fig. 4b

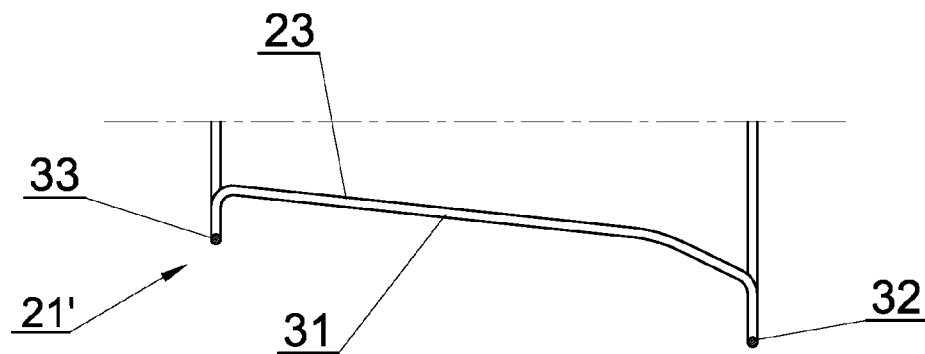


Fig. 4c

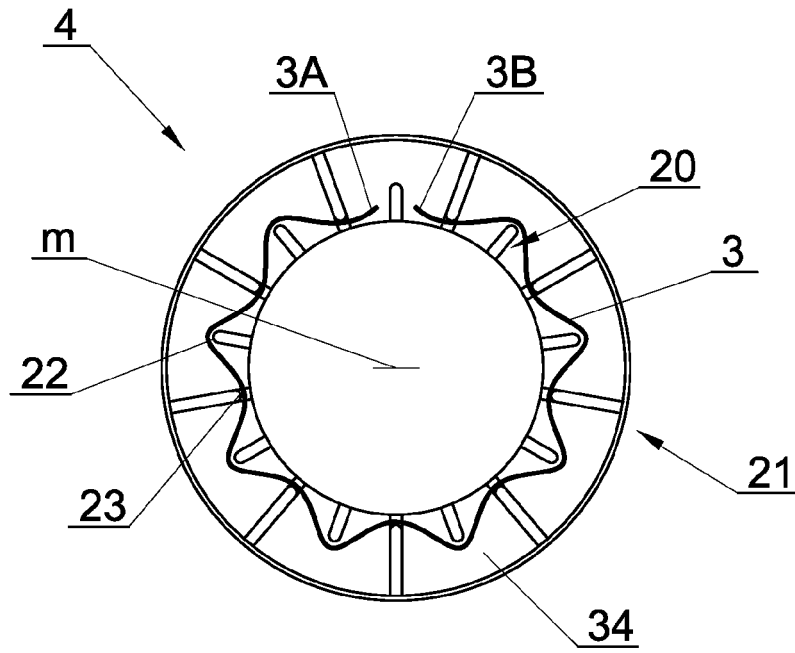


Fig. 5

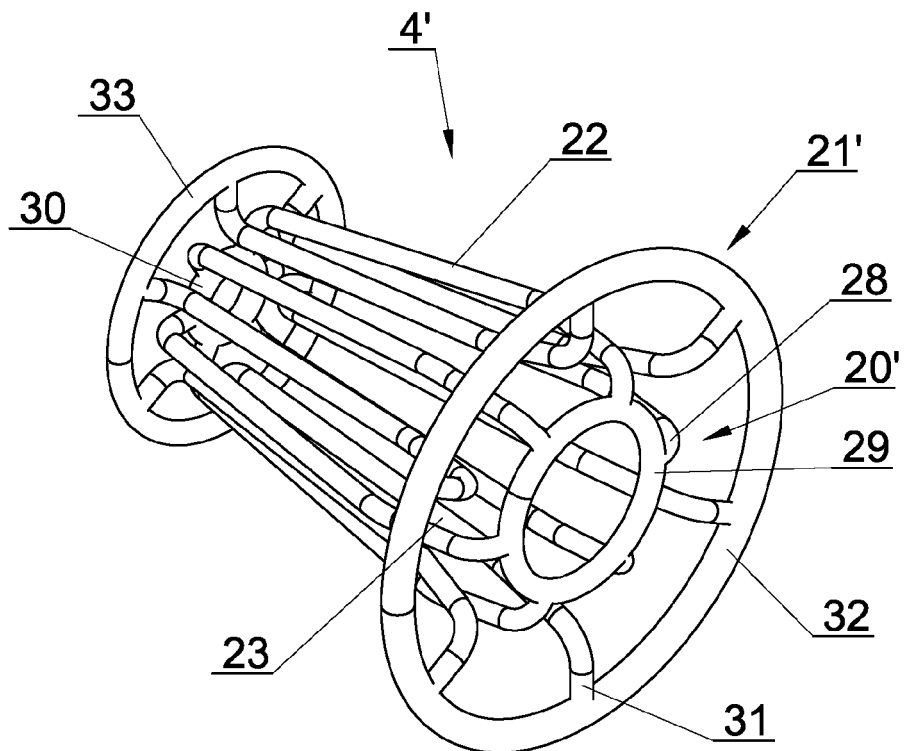


Fig. 6

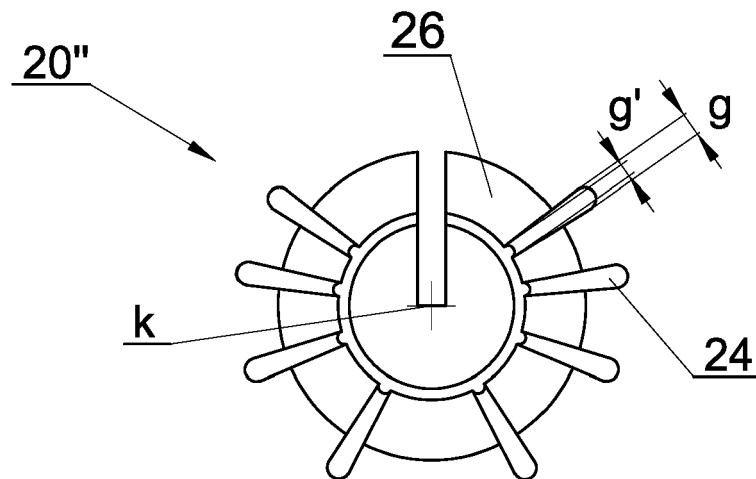


Fig. 7

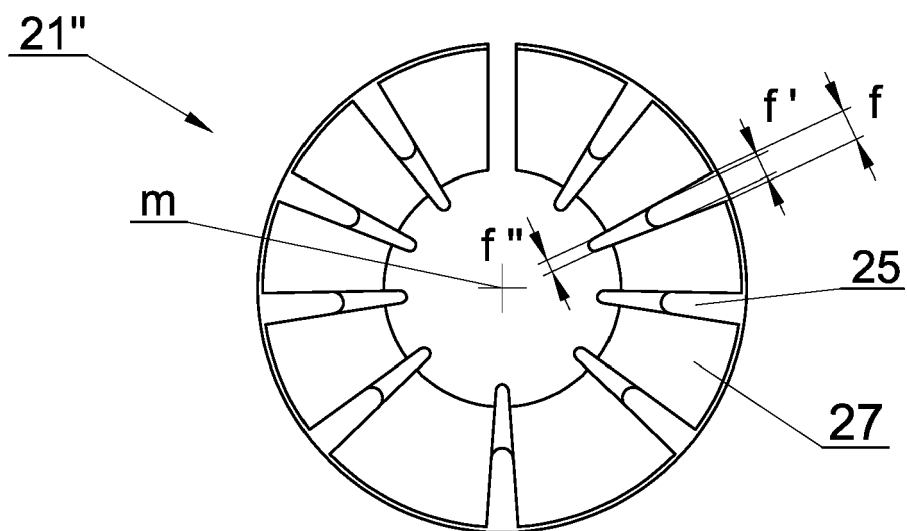


Fig. 8

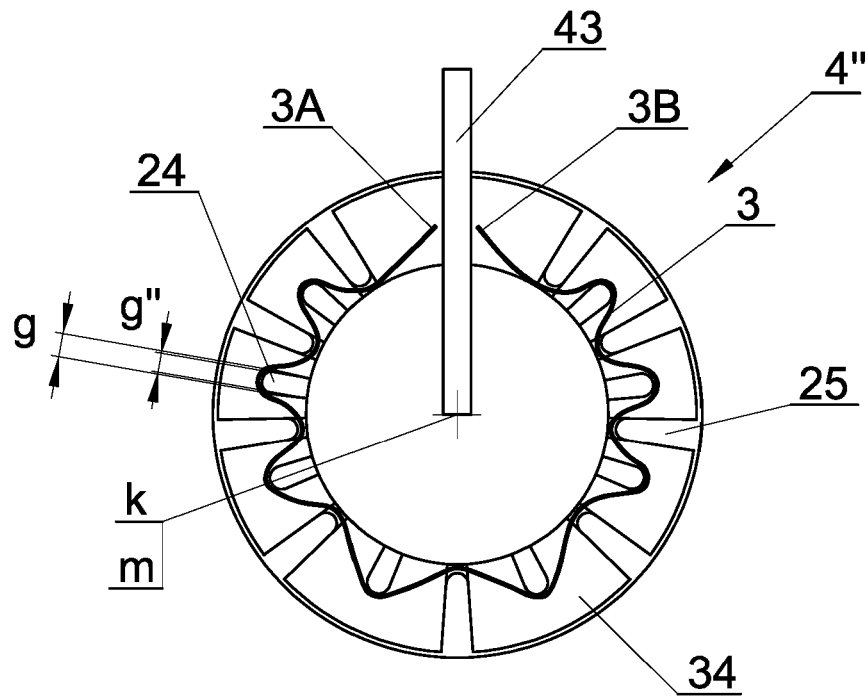


Fig. 9

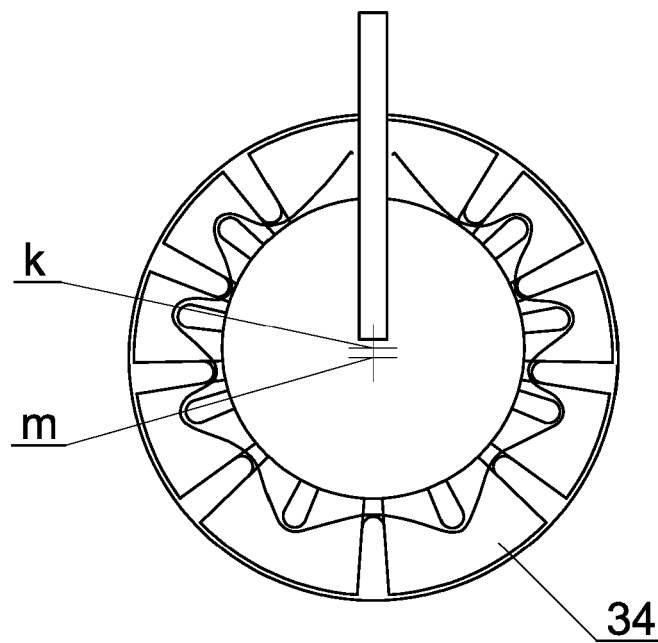


Fig. 10

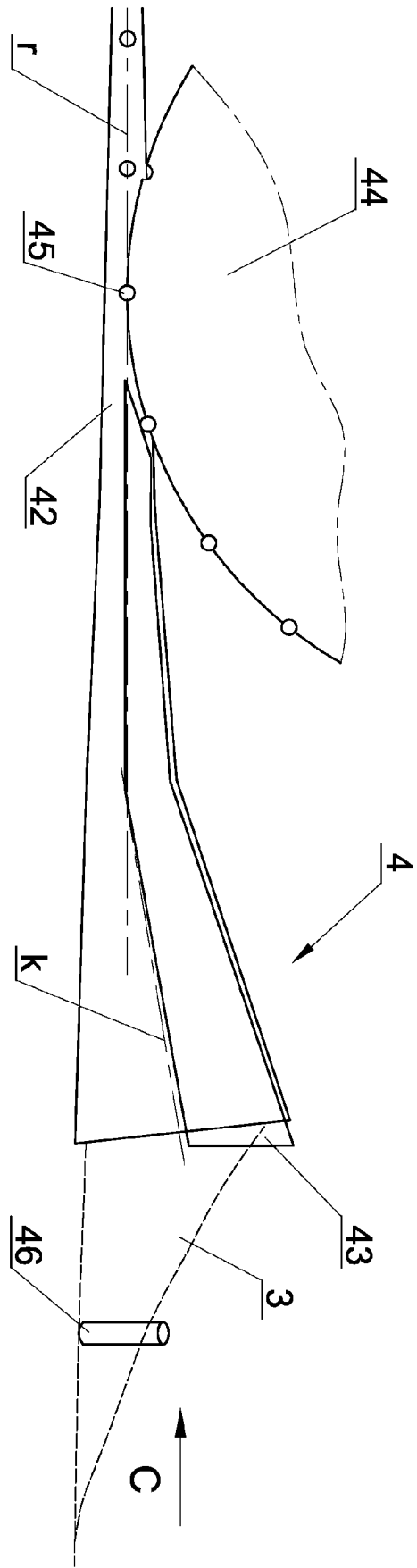


Fig. 11a

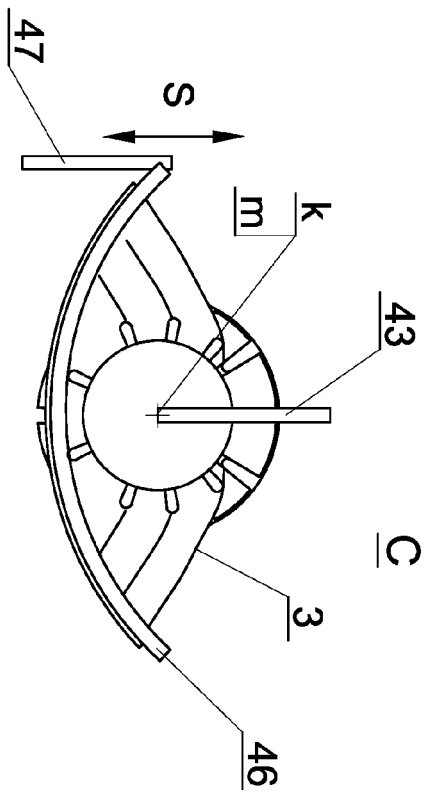
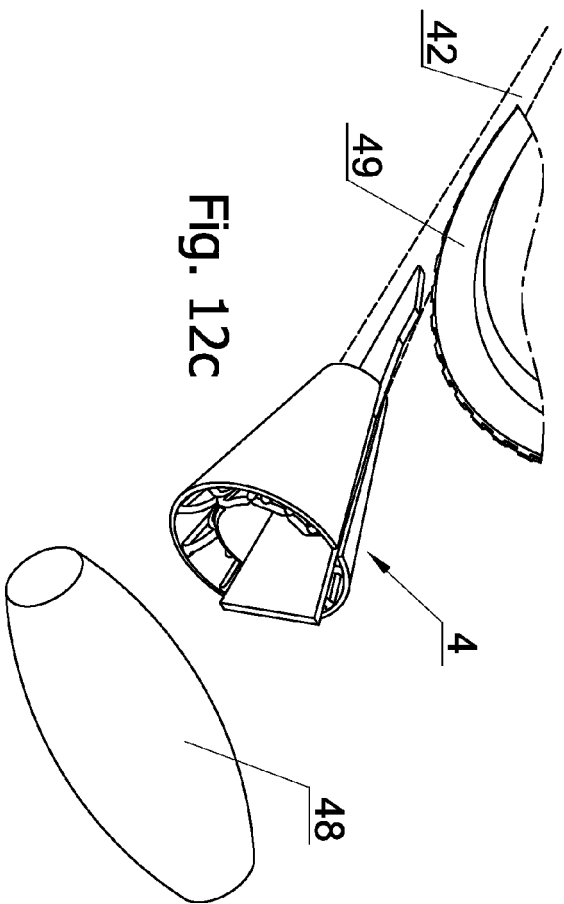
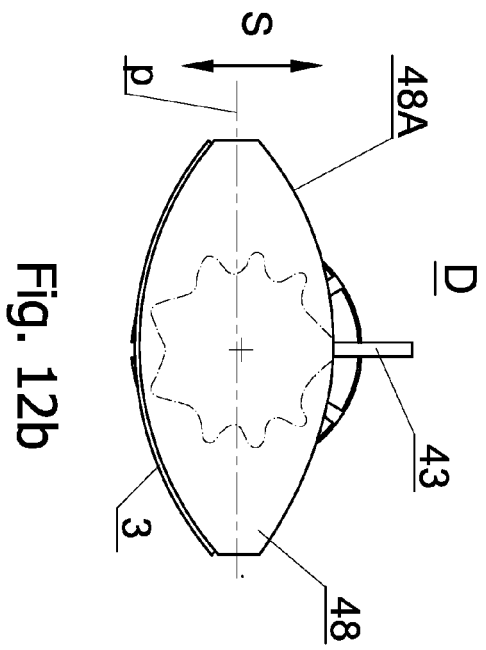
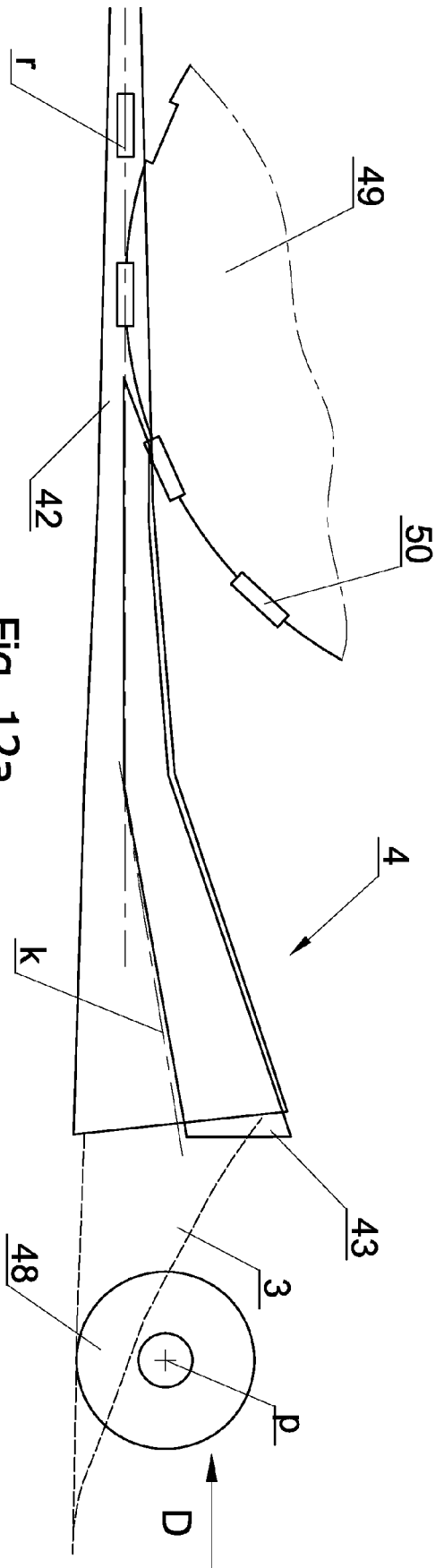


Fig. 11b



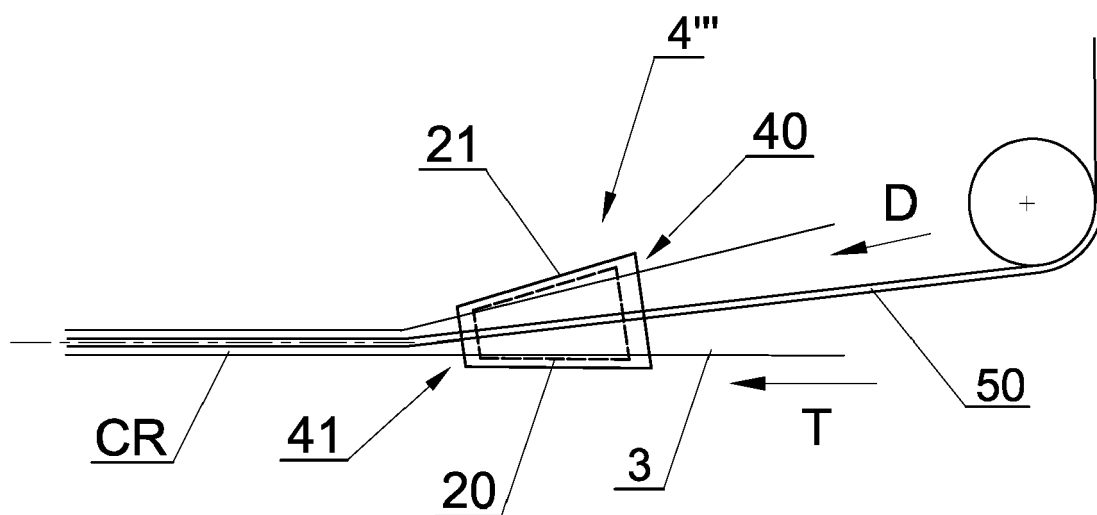


Fig. 13a

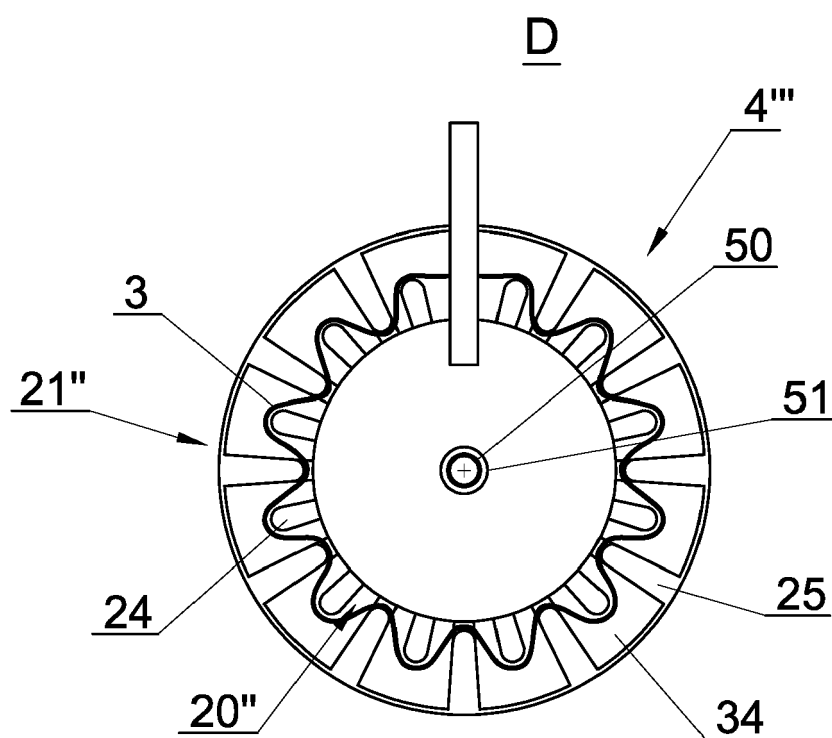


Fig. 13b

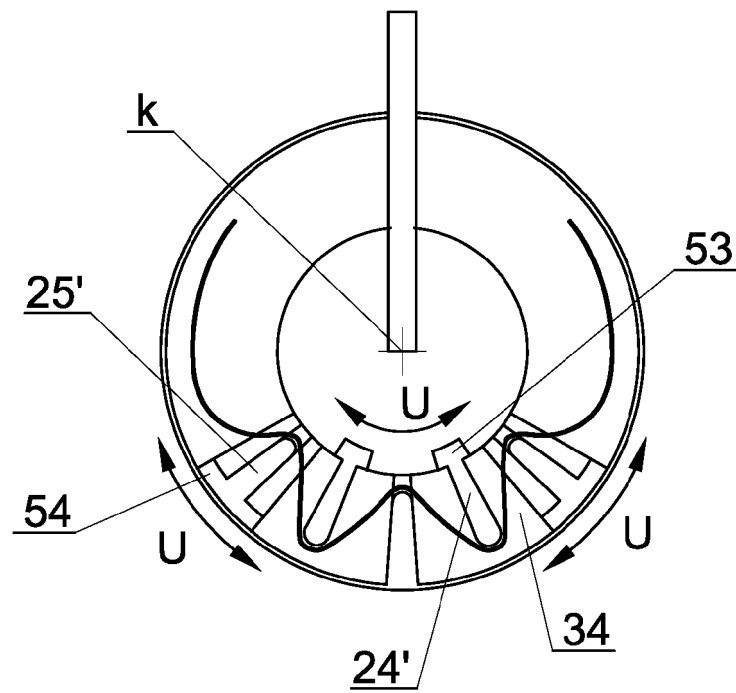


Fig. 14

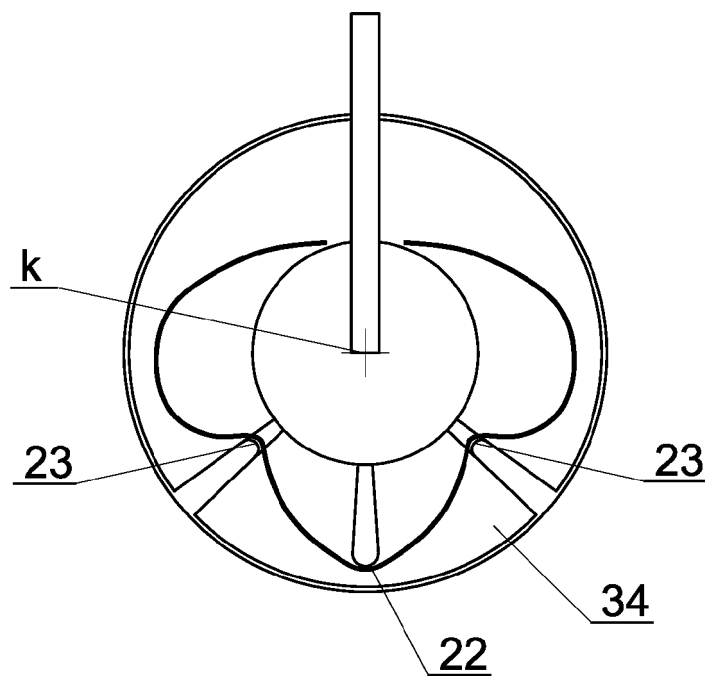


Fig. 15

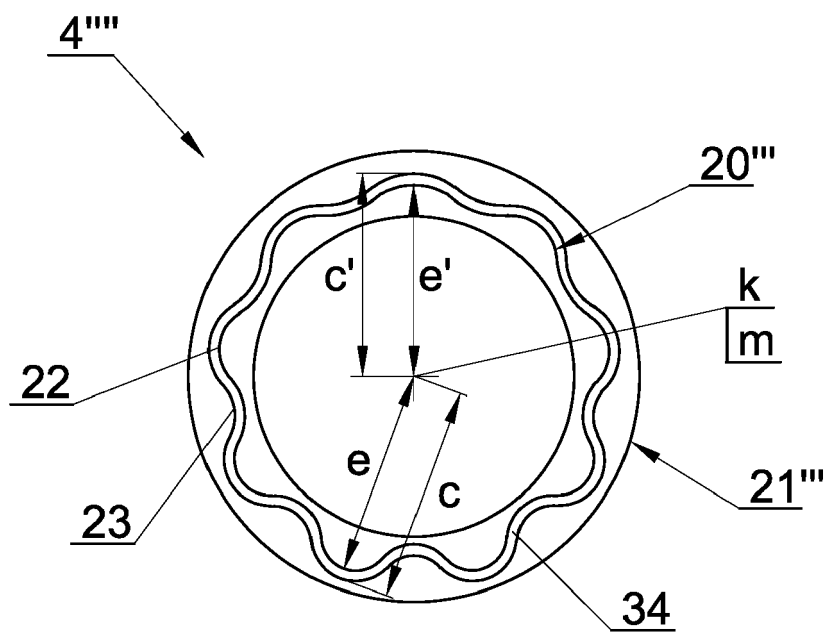


Fig. 16



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X	US 2020/337362 A1 (ZAPPOLI STEFANO [IT]) 29 October 2020 (2020-10-29)	1, 6-10, 12-15	INV. A24D3/02
A	* paragraph [0035] - paragraph [0110]; figures 1-5 *	2-5, 11	B31D5/00 B31F1/20 B31F1/22
A	US 2021/378288 A1 (CIESLIKOWSKI BARTOSZ [PL] ET AL) 9 December 2021 (2021-12-09) * paragraph [0059] - paragraph [0078]; figures 1-22 *	1-15	
A	US 2 935 003 A (HARRIS EDWARD P) 3 May 1960 (1960-05-03) * column 2, line 56 - column 4, line 47; figures 1-6 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			A24D B31F B31D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 31 July 2023	Examiner Espla, Alexandre
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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31-07-2023

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