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(54) FEEDING MODULE FOR FEEDING SEGMENTS IN THE FORM OF ROD-LIKE ARTICLES, APPARATUS AND METHOD FOR MANUFACTURING MULTI-SEGMENT ARTICLES

(57) An apparatus (1) for manufacturing multi-segment articles comprising at least two feeding modules (20), the feeding module (20) being adapted to cut a rod (MA, MB, MC, MD) into segments (A, B, C, D) and to feed the segments (A, B, C, D) to an assembling unit (30), the assembling unit (30) being provided with assembling drums (31) and conveying drums (32) for receiving the segments (A, B, C, D) from the feeding modules (20) and forming a segment group (G1), a first wrapping module (40) for feeding a section of a first wrapping material (W1) and wrapping the segment group (G1) supplied from the assembling unit (30) so as to form a multi-segment rod (R), a cutting unit (50) for cutting the formed rod (R) into half multi-segment rods (R1, R2), an additional feeding module (70) for cutting an additional rod (ME) and feeding additional segments (E) between the half multi-segment rods (R1, R2), whereas the additional feeding module (70) comprises a cutting head (74), situated at the conveying drum (73), for cutting the rod into individual segments, and a second wrapping module (80) for feeding a section of a second wrapping material (W2) and wrapping the two half multi-segment rods (R1, R2) and the additional segment (E).

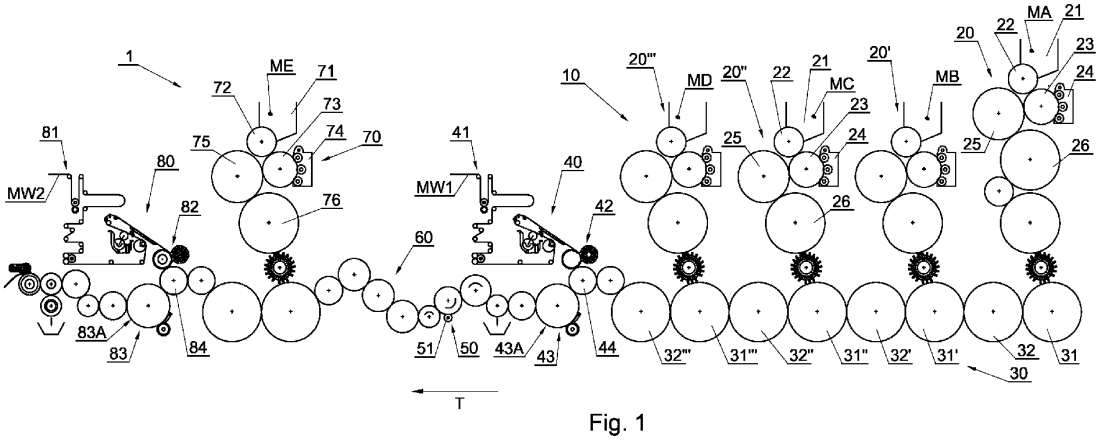

Fig. 1

EP 4 374 714 A1

Description

[0001] The object of this application is a feeding module for feeding segments in the form of rod-like articles, an apparatus and a method for manufacturing multi-segment articles.

[0002] At present, the tobacco industry manufactures rod-like articles comprising a plurality of elements, namely tobacco elements containing tobacco or material containing processed tobacco, filter elements, elements containing aromatic substances, distance elements used for example to cool tobacco smoke. In this application, these various elements will be referred to as segments and articles containing such segments as multi-segment articles or multi-segment rods. In the process of manufacturing multi-segment filter rods or multi-segment smoking articles, the segments are usually manufactured by cutting the rods that are multiples of the segments. The patent EP2230951B1 discloses an apparatus for assembling groups of segments which are used in the process of manufacturing multi-segment articles, the rods are received from a hopper and cut on a single multi-segment conveyor drum. In the state of the art, there are known many apparatuses on which the rods are cut into individual segments, such apparatuses are disclosed among others in the documents GB2267021A, EP1393640A1, EP1397965A1, EP1493340A1.

[0003] The tobacco industry uses active quality control that includes the rejection of defective rods. The active rejection of defective rods is one of the processes that affect the filling of conveying flutes of conveying drums, a problem that is solved, for example, by filling up the rods or by adjusting the rotational speed of the conveying drum that transfers the rods further through the processing line. Processes involving an increase in speed adversely affect the process of cutting rod-like articles which, in order to maintain the quality of the products, requires the feed speed of the articles to be cut to be as constant as possible. Therefore, there is a need for apparatuses wherein both processes with a variable rotational speed and processes requiring a constant conveyor drum speed are possible. In the state-of-the-art documents presented, the conveying drums on which cutting takes place cannot be accelerated. There is a need for the rod receiving process to be independent of the rod cutting process.

[0004] The object of the invention is a feeding module for feeding segments in the form of rod-like articles, comprising a hopper for storing rods, a receiving drum for receiving the rods from the hopper, a conveying drum, a cutting head, situated at the conveying drum, for cutting the rods into individual segments, a shifting drum for varying the mutual position of the segments, an aligning drum for forming at least one stream of the segments.

[0005] The feeding module according to the invention is further characterised in that the feeding module comprises a filling sensor for checking the presence of the rod in a flute of the receiving drum.

[0006] The feeding module according to the invention is further characterised in that the feeding module comprises a quality control sensor for the rod.

[0007] The feeding module according to the invention is further characterised in that the feeding module comprises a rod rejector for rejecting the rod from the flute of the receiving drum.

[0008] The feeding module according to the invention is characterised in that the receiving drum is adapted to make a rotational movement at an increased speed so that when an unfilled flute on the receiving drum is detected or a rod is rejected from a flute on the receiving drum, it moves at the increased speed so that at the point of transfer of the rod into the flute of the conveying drum, there is another filled flute of the receiving drum and another empty flute of the conveying drum.

[0009] The feeding module according to the invention is further characterised in that the feeding module is provided with a replenishing apparatus for feeding the rod into the flute of the receiving drum.

[0010] The feeding module according to the invention is further characterised in that the filling apparatus comprises an additional hopper for the rods.

[0011] Furthermore, the object of the invention is an apparatus for manufacturing multi-segment articles comprising at least two feeding modules for feeding the segments formed after cutting the rods according to the invention, and an assembling unit provided with assembling drums and conveying drums, for receiving the segments from the feeding modules and forming a group of the segments, a first wrapping module for feeding a section of a first wrapping material and wrapping the group of the segments which have been pushed together so as to form a multi-segment rod, a cutting unit for cutting the formed rod into half multi-segment rods. The apparatus according to the invention further comprises an additional feeding module according to the invention for cutting an additional rod and feeding additional segments between the half multi-segment rods, and a second wrapping module for feeding a section of a second wrapping material and wrapping the two half multi-segment rods and the additional segment.

[0012] The object of the invention is also a method of manufacturing multi-segment articles comprising steps wherein, in the feeding modules, the rods are fed from a hopper for storing the rods by means of a receiving drum for receiving the rods, the rods are cut into segments by means of a cutting head, situated at the conveying drum, for cutting the rods into individual segments, the segments are fed to an assembling unit, via the shifting drum for varying mutual position of the segments and an aligning drum for forming at least one stream of the segments, then segment groups are formed in the assembling unit provided with the assembling drums and the conveying drums for receiving the segments from the feeding modules, the segments are pushed together in the group so that the segments are in contact with one another. In a further step, a section of a first wrapping material is fed

in a first wrapping module and a group of the segments which have been pushed together is wrapped whereby the multi-segment rod is formed, whereas by means of the conveying drum the groups of the segments are received and the groups of the segments which have been pushed together are conveyed along with the section of the first wrapping material, and then the groups of the segments which have been pushed together are wrapped with the section of the first wrapping material.

[0013] In the next step, in the cutting unit, the formed multi-segment rod is cut into half multi-segment rods, in an additional feeding module for cutting the additional rod and feeding additional segments between the half multi-segment rods: the rods are received from the hopper, the rods are conveyed by means of the conveying drum, then the cutting head cuts the rods into individual segments, with the cutting head being situated at the conveying drum, then the mutual position of the segments is varied by means of the shifting drum and at least one stream of the segments is formed by means of an aligning drum. In the next step, a section of a second wrapping material is fed and the two half multi-segment rods and the additional segment are wrapped by means of a second wrapping module.

[0014] The method according to the invention is further characterised by comprising a step wherein an empty flute on the drum is identified, and once the empty flute on the receiving drum is identified, the speed of the receiving drum is increased relative to the speed of the conveying drum so that at the point of transfer of the rod into the flute of the conveying drum, there is another filled flute of the receiving drum and another empty flute of the conveying drum.

[0015] The method according to the invention is further characterised in that the step of identifying the empty flute is carried out by using a filling sensor for checking the presence of the rod in the flute.

[0016] The method according to the invention is characterised in that the step of identifying the empty flute is carried out by means of a defective rod rejection signal from a sensor of rod quality control.

[0017] The method according to the invention is characterised in that the empty flute is filled with a rod from the additional hopper by means of a rotational inserting element adapted to feed the rods individually into the flute.

[0018] An advantage of the invention is that it allows the cutting process to be carried out at a constant speed of the conveying drum in an apparatus in which a variable speed of feeding the rod-like articles over the drums is used.

[0019] The object of the invention is described in more detail on the basis of embodiments shown in a drawing in which:

Fig. 1 shows an apparatus for manufacturing multi-segment articles,

Fig. 2a shows, in simplified terms, the process stages for manufacturing the multi-segment articles in the first embodiment,

Fig. 2b shows, in simplified terms, the process stages for manufacturing the multi-segment articles in the second embodiment,

Fig. 3 shows a feeding module in the first embodiment,

Fig. 3a shows a rod and a group of segments formed after cutting the rod,

Fig. 3b shows the process of forming a segment stream,

Fig. 3c shows the process of forming two segment streams,

Fig. 4 shows the phases of momentary acceleration of a receiving drum,

Fig. 5 shows the feeding module in the second embodiment, and

Fig. 6 shows the feeding module in the third embodiment.

[0020] Fig. 1 shows an apparatus 1 for manufacturing multi-segment articles, comprising an assembling apparatus 10, a first wrapping module 40, a cutting unit 50, a reorienting unit 60, an additional feeding unit 70 and a second wrapping module 80.

[0021] The assembling apparatus 10 comprises at least two feeding modules 20 and an assembling unit 30, in the shown embodiment the assembling apparatus 10 comprises four feeding modules 20, 20', 20", 20‴. The feeding module 20, 20', 20", 20'" is adapted to cut rods of at least one type and to feed segments of at least one type. Feeding modules which are adapted to cut rods of two types and to feed segments of two types are also known.

[0022] The feeding module 20 comprises a hopper 21 for the rods MA, a receiving drum 22 provided with circumferentially arranged flutes in which the rods MA from the hopper 21 are situated, and drums for forming a stream of segments A formed by cutting the rods MA. The receiving drum 22 receives the rods MA from the hopper 21 and conveys the rods to the conveying drum 23. At the conveying drum 23, there is arranged a cutting head 24 which is provided with one or more circular knives 24A for cutting the rods MA. The feeding module 20 comprises at least one shifting drum 25 and at least one aligning drum 26. The shifting drum 25 may also be referred to as a cascading drum wherein successive segments are arranged in successive flutes of this drum. The feeding module 20 supplies the segments A in the form

of at least one stream. In the embodiment shown, in the feeding modules 20, 20', 20", 20"', the rod MA, MB, MC, MD is cut into segments A, B, C, D respectively, the segments being fed in the form of streams to the assembling unit 30.

[0023] The rods MA stored in the hopper 21 fill the flutes 28 arranged circumferentially on the receiving drum 22 during the rotation of this drum (Fig. 3). The rods MA are held in the flutes 28 by means of vacuum supplied through holes in the bottom of the flute 28. The receiving drum 22 transfers the rods MA at the transfer point X to the flutes 29 of the conveying drum 23 where the rods MA are also held by means of vacuum. The rod MA is cut into individual segments A, with the segments A formed from one rod MA forming a segment group G (Fig. 3a). The consecutively fed groups G of the segments A are transferred to the shifting drum 25 and further to the aligning drum 26 to form a stream of individual segments A in which the segments A move so that their axes are situated perpendicular to the direction of movement. The feeding module 20 supplies the segments A in the form of at least one stream of the segments A. An example of a stream of the segments A formed by cutting the rods MA is shown in Fig. 3b, the drums are not shown, there are presented the rods MA and the segments A are situated successively on the receiving drum 22, the conveying drum 23, the shifting drum 25 and the aligning drum 26. The shifting drum 25 varies the arrangement of the segments A with respect to one another, the shifting drum 25 may also be referred to as the cascading drum. On the drum 26, the segments A are positioned so that they move along a single path of movement, in the view of the lateral surface of the drum along a single line. Fig. 3c shows the forming of two streams of the segments A produced by cutting of the rods MA. The stream of the segments A can be transferred further to an assembling unit 30 of the assembling module of the machine for manufacturing the multi-segment articles.

[0024] On the receiving drum 22, the quality control of the rods MA can be carried out. At the receiving drum 22, there may be situated a rejector for removing defective rods from the process. Due to the location of the cutting process on the conveying drum 23, the receiving drum 22 may momentarily vary the speed in order to correct the efficiency of feeding the rods MA from the receiving drum 22 to the conveying drum 23.

[0025] In the first embodiment shown in Fig. 3, the feeding module 20 is provided with a filling sensor 91 for checking the presence of the rod MA in the flute 28 of the receiving drum 22. Furthermore, the feeding module 20 comprises a quality control sensor 92 for checking the quality of the conveyed rods MA.

[0026] The feeding module 20 comprises a rod rejector 93 for rejecting defective rods MA. The rejector 93 comprises a pressure vessel 94 and a valve 95 on a feed channel 96 through which compressed air is supplied. The rejection of the rod MA is achieved by momentarily supplying compressed air to a rejection channel 97. The rejection force acting on the rod MA is greater than the force holding the rod MA in the flute 28. In Fig. 3, the rejected defective rod is indicated as MA'.

[0027] The receiving drum 22 is adapted to operate at a variable and adjustable rotational speed, preferably with position control, for example by coupling the receiving drum 22 to a digitally controlled servo drive which is provided with a position encoder. The rotational speed $\omega 1$ of the receiving drum 22 is synchronised with the rotational speed $\omega 2$ of the conveying drum 23, the synchronisation of the receiving drum 22 and the conveying drum 23 being maintained when all flutes 28 of the receiving drum 22 are filled. During the operation of the feeding module 20, individual flutes 28 may be unfilled. The occurrence of an unfilled flute 28' may be due to a momentary ineffective receiving of the rod MA' from the hopper 21. An unfilled flute 28' will also occur when a defective rod MA' is detected by the quality control sensor 92 and the rejector 93 is activated. When a low-quality rod MA' is detected by the sensor 92, the rejector 93 rejects such a defective rod. In Fig. 3a, the flute 28' is denoted as the flute from which the defective rod MA' was rejected after activation of the rejector 93. Hereinafter, the flute 28' will denote both a flute from which a defective rod was rejected and a flute that was not filled by the rod MA from the hopper 21.

[0028] The receiving drum 22 is adapted to transfer the rod MA at the transfer point X from the flute 28 of the receiving drum 22 to the flute 29 of the conveying drum 23, the receiving drum 22 rotating at a speed $\omega 1$ and the conveying drum 23 rotating at a speed $\omega 2$ adjusted to the speed $\omega 1$ so that the linear speeds of the receiving drum 22 and the conveying drum 23 are equal. The feeding module 20 is adapted to momentarily accelerate the receiving drum 22 before the unfilled flute 28' of the receiving drum 22 reaches the transfer point X. Namely, the receiving drum 22 is adapted to make a rotational movement with an increased speed $\omega 1'$ so that when an unfilled flute 28' of the receiving drum 22 is detected, the receiving drum 22 moves with an increased speed $\omega 1'$ so that at the transfer point X of the rod MA to the flute 29 of the conveying drum 23, there is another filled flute 28" of the receiving drum 22 and another empty flute 29' of the conveying drum 23. An effect of the acceleration of the receiving drum 22 is that all flutes 29 on the conveying drum 23 are filled, i.e. the "unfilling" of the flute 28' is not transferred to the conveying drum 23.

[0029] Fig. 4 shows the successive phases of movement of the receiving drum 22 to be carried out in order to eliminate the "unfilling", the shown phases of movement include the acceleration of the receiving drum 22, the figure also shows the phases of movement of the conveying drum 23 related to the movement of the receiving drum 22. In the phase a, the rod MA is transferred to the flute 29 and the receiving drum 22 moves at a nominal rotational speed $\omega 1$ adjusted to the rotational speed $\omega 2$ of the conveying drum 23. On the conveying drum, the next flute to be filled is designated as 29', the

flute 28' which approaches the transfer point X being unfilled. Just after transferring the rod MA to the flute 29 of the conveying drum 23, the receiving drum 22 starts to move at an increased speed ω1', as shown in the phase b, where the flute 28' moves faster than the flute 29' to be filled with the next rod MA. In the phase c, the receiving drum 22 continues to rotate at the increased speed ω1' and the conveying drum 23 rotates at the nominal speed ω2. In the phase d, the filled flute 28' of the receiving drum 22 and the empty flute 29' of the conveying drum 23 are positioned opposite each other, i.e. their movements are synchronised so that the rod MA can be transferred between the flutes, whereas the receiving drum 22 reduces its speed to the nominal rotational speed ω1 and the conveying drum 23 rotates at the nominal rotational speed ω2. The receiving drum 22 and the conveying drum 23 continue to rotate synchronously with the speeds ω1 and ω2, respectively, enabling the transfer of the successive rods MA.

[0030] An assembling unit 30 comprises assembling drums 31 and conveying drums 32 which are provided with flutes into which the segments are received and conveyed. The assembling drum 31, 31', 31", 31‴ is adapted to receive and to convey a stream of the segments A, B, C, D, respectively. The first assembling drum 31 is adapted to receive only the segments A, while the assembling drum 31' is adapted to receive a stream of the segments A from the feeding module 20 via the conveying drum 32 and to receive a stream of the segments B from the feeding module 20', the streams of the segments A and B being assembled on the assembling drum 31'. Similarly, on the assembling drum 31", the streams of the segments A, B are received together, and the stream of the segments C is received from the feeding module 20". On the assembling drum 31‴, the streams of the segments A, B, C are received together, and the stream of the segments D is received from the feeding module 20'". In the assembling unit 30, the streams of the segments A, B, C, D are arranged in such a way that adjacent segments in the flutes are spaced apart. The assembling unit 30 is adapted to feed the group G1 comprising the segments A, B, C, D. Due to the adaptation of the assembling unit 30 to form a group of segments with spacing, the segments A, B, C, D can be fed in any order, the examples of forming processes being described below in this description.

[0031] The first wrapping module 40 comprises a feeding unit 41 for feeding a first wrapping material MW1, a cutting unit 42 for cutting the strand of the first wrapping material MW1 into sections of the first wrapping material W1, and a rolling unit 43 for wrapping the group of segments. The first wrapping module 40 comprises a conveying drum 44 which is adapted to receive and to convey the group of segments, once the group of segments G1 has been assembled in the assembling unit, the segments of the group G1 are pushed together so as to form the group G2 in which the segments touch the ends of one another, the pushing being performed by mechanisms known in the state of the art before wrapping with the section of the first wrapping material. The rolling unit 43 is adapted to wrap a section of the first wrapping material W1 around the group G2. The rod thus formed is designated as R (stage g).

[0032] The cutting unit 50 situated downstream of the first wrapping module 40 in the direction T of the process of manufacturing the multi-segment articles is provided with a circular knife 51 for cutting the multi-segment rod R into two halves, i.e. into two half multi-segment rods designated as R1 and R2 (stage h in Fig. 2). The cutting is effected so that the segment B of the multi-segment rod R is cut into two halves.

[0033] The reorienting module 60 is adapted to vary the orientation of the half multi-segment rods R1 and R2 with respect to each other, i.e. to vary the mutual position of the rods R1 and R2 while they are conveyed. The reorienting module 60 may be provided with reorienting drums known in the tobacco industry which, in addition to circumferential conveying, reorient the conveyed rod-like articles axially and/or transversely to the axes of such articles. The reorienting module 60 may be provided with rotating drums known in the tobacco industry which, in addition to circumferential conveying, rotate the conveyed rod-like articles around axes which are substantially perpendicular to the circumferential surface. The reorienting module 60 is adapted to vary the positioning of the rod-like articles R1 and R2 relative to each other. As a result of the operation of the reorienting module 60, the rods R1 and R2 are reoriented so that the segments D being the ends of the rods R1 and R2, originally oriented away from each other, are oriented towards each other, while the half segments B, arranged opposite to the segments D in the rods R1 and R2, originally oriented towards each other, are oriented away from each other. In addition, the rods R1 and R2 become coaxially situated, and there will be a gap maintained between the rods R1 and R2.

[0034] The additional feeding module 70 comprises a hopper 71, a receiving drum 72 provided with circumferentially arranged flutes in which the rods ME from the hopper 71 are placed (the structure of the additional feeding module 70 is the same as that of the first feeding module 20). The rods ME are conveyed to a conveying drum 73. At the conveying drum 73, there is situated a cutting head 74 which is provided with one or more circular knives for cutting the rods. The additional feeding module 70 comprises at least one shifting drum 75 and at least one aligning drum 76. The additional feeding module 70 is adapted to feed a stream of additional segments E. After feeding the additional segment E, there is formed a group S1 including a half multi-segment rod R1, a segment E and a half multi-segment rod R2 with gaps.

[0035] The additional feeding module 70 is constructed similar to the feeding module 20 described above, namely it is provided with a filling sensor 91 for checking the presence of the rod MA in a flute of the receiving drum

72. Furthermore, the feeding module 70 comprises a quality control sensor 92 for checking the quality of the conveyed rods MA. The feeding module 70 comprises a rod rejector 93 for rejecting defective rods MA which comprises a pressure vessel 94 and a valve 95 on a feed channel 96 through which compressed air is supplied.

[0036] The second wrapping module 80 comprises a feeding unit 81 for feeding a second wrapping material MW2, a cutting unit 82 for cutting the second wrapping material MW2 into sections of the second wrapping material W2, and a rolling unit 83. The second wrapping module 80 comprises a conveying drum 84 which is adapted to receive and to convey a group S1 which includes a half multi-segment rod R1, a segment E and a second half multi-segment rod R2. The group of elements R1, E, R2 which have been pushed together is designated as S2. The conveying drum 84 is adapted to convey the group S2 of the elements R1, E, R2 pushed together, along with a section of the second wrapping material W2. The rolling unit 83 is adapted to wrap the section of the second wrapping material W2 around the group S2 on the rolling drum 83A. The rod thus formed is designated as P.

[0037] In the process of manufacturing the multi-segment rod shown in simplified terms in Fig. 2a, the feeding module 20 cuts the rods MA into the segments A and feeds two segments A to the assembling unit 30 (stage a in Fig. 2a), the feeding module 20' cuts the rods MB and feeds the segment B (stage b), the feeding module 20" cuts the rods MC and feeds two segments C (stage c), the feeding module 20‴ cuts the rods MD and feeds two segments D (stage d). The segments A, B, C, D are conveyed in the assembling unit 30, whereas the assembling unit 30 supplies the segment group G1 comprising the segments A, B, C, D. The segments A, B, C, D are further conveyed and are pushed together, whereas the segments A, B, C D which have been pushed together form the segment group G2 (step e). In the wrapping module 40, sections of the first wrapping material W1 are cut from the strand of the first wrapping material MW1 and are wrapped around the segment group G2 (stage f), after wrapping on the rolling drum 43A by means of the rolling unit 43B, the rod R is formed (stage g). The rod R is cut by the cutting unit 50 into two half multi-segment rods R1 and R2 (stage h), whereas the rods R1 and R2 are adjacent to each other with the half segments B and are positioned coaxially. The rods R1 and R2 are reoriented in the reorienting unit 60 (stages i, j, k, l, m, n) so that, after reorienting, they are again positioned coaxially, with a gap, with opposite ends than initially, namely the half segments B are oriented away from each other, while the segments D are oriented towards each other. In the process of reorienting the rods R1 and R2 shown in Fig. 2a, the reorientation is carried out by rotating the rods R1 and R2 shown in the stage k, and the stages j and I represent the movement of the rods before and after rotation, whereas these stages may be omitted. The additional feeding module 70 cuts the rods ME into the segments E and feeds the segments E between the rods R1 and R2, after inserting the segment E a group S1 including the rod R1, the segment E and the rod R2 is formed (stage o), with gaps between the rods R1, the rods R2 and the segment E being maintained. After pushing the rods R1, R2 and the segment E together, a group S2 with no gaps among the rods R1, R2 and the segment E is formed (stage p). In the second wrapping module 80, sections of the second wrapping material W2 are cut from the strand of the second wrapping material MW2 and are wrapped around the segment group S2 (stage r), after wrapping on the rolling drum 83A by means of the rolling unit 83, the rod P is formed (stage s).

[0038] In the process of manufacturing the multi-segment rod in the second embodiment shown in simplified terms in Fig. 2b, the feeding module 20 cuts the rods MB into the segments B and feeds the segment B to the assembling unit 30 (stage a in Fig. 2b), the feeding module 20' cuts the rods MA and feeds two segments A (stage b), the feeding module 20" cuts the rods MD and feeds two segments D (stage c), the feeding module 20‴ cuts the rods MC and feeds two segments C (stage d). The process stages e to h are carried out as described for the first embodiment. At the stages i, j the half multi-segment rods R1 and R2 are displaced transversely to the axis of the rods R1, R2, at the stages k, l, m the rods R1, R2 are reoriented so that after the axial displacement of the rods R1, R2 the half segments B are oriented away from each other, while the segments D are oriented towards each other. At the stages m and n the rods R1 and R2 are displaced transversely to their axes so that the rods R1 and R2 are positioned coaxially. The further process is carried out as in the first embodiment.

[0039] In the second embodiment shown in Fig. 5, the feeding module is provided with a quality control sensor 92 for checking the quality of the conveyed rods MA, a replenishing apparatus 98 for feeding the rods MA and the rejector 93. The rejector 93 for removing defective rods comprises the pressure vessel 94, the valve 95 and the feed channel 96. When a low-quality rod is detected by the sensor 92, a controller S receives a signal indicating a defective rod MA' and sends the signal to the rejector 93 so that the rejector 93 rejects such a defective rod MA', compressed air gets through the suplly channel 96 and the channel 97 to the rod MA' in the flute 28'. The replenishing apparatus 98 fills the empty flute 28' with a rod from an additional hopper 99, the replenishing apparatus 98 being provided with a rotational inserting element 100 adapted to feed the rods MA individually into the flute 28. During the operation of the feeding module, the receiving drum 22 moves at a constant rotational speed $\omega 1$, while the conveying drum 23 moves at a speed $\omega 2$ adapted to the speed $\omega 1$.

[0040] In the third embodiment shown in Fig. 6, the feeding module is provided with the filling sensor 91 for checking the presence of the rod MA in the flute 28 of the receiving drum 22 and the filling apparatus 98 for feeding the rods MA. When the sensor 91 detects the

absence of the rod MA in the flute 28', the controller S receives a signal indicating the absence of the rod and sends the signal to the filling apparatus 98 so that the empty flute 28' becomes filled with the rod MA. The filling apparatus 98 is provided with an inserting mechanism 101 which receives the rod MA from the additional hopper 99 and places it in the empty flute 28'. During the operation of the feeding module, the receiving drum 22 moves at the constant speed ω1, while the conveying drum 23 moves at the speed ω2 adapted to the speed ω1.

Claims

1. A feeding module (20, 70) for feeding segments in the form of rod-like articles, comprising

   a hopper (21, 71) for storing rods (MA),
   a receiving drum (22, 72) for receiving the rods (MA) from the hopper (21, 71),
   a conveying drum (23, 73),
   a cutting head (24, 74), situated at the conveying drum (23, 73), for cutting the rod (MA) into individual segments (A),
   a shifting drum (25, 75) for varying the mutual position of the segments (A),
   an aligning drum (26, 76) for forming at least one stream of the segments (A).

2. The feeding module as in claim 1, **characterised in that** the feeding module (20, 70) comprises a filling sensor (91) for checking the presence of the rod (MA) in a flute (28) of the receiving drum (22, 72).

3. The feeding module as in claim 1 or 2, **characterised in that** the feeding module (20, 70) comprises a quality control sensor (92) for the rod (MA).

4. The feeding module as in claim 3, **characterised in that** the feeding module (20, 70) comprises a rod rejector (93) for rejecting the rod (MA') from the flute (28) of the receiving drum (22, 72).

5. The feeding module as in any of the claims 2 to 4, **characterised in that** the receiving drum (22) is adapted to make a rotational movement at an increased speed (ω1') so that when an unfilled flute (28') on the receiving drum (22) is detected or a rod (MA') is rejected from the flute (28') on the receiving drum (22), it moves at the increased speed (ω1') so that at the point of transfer (X) of the rod (MA) into the flute (29) of the conveying drum (23), there is another filled flute (28") of the receiving drum (22) and another empty flute (29') of the conveying drum (23).

6. The feeding module as in any of claims 2 to 4, **characterised in that** the feeding module (20, 70) is provided with a replenishing apparatus (98) for feeding the rod (MA) into the flute (28) of the receiving drum (22, 72).

7. The feeding module as in any of the claims 1 to 4, **characterised in that** the replenishing apparatus (98) comprises an additional hopper (99) for the rods (MA).

8. An apparatus (1) for manufacturing multi-segment articles comprising

   at least two feeding modules (20) for feeding segments (A, B, C, D) formed after cutting rods (MA, MB, MC, MD) according to any of claims 1 to 7,
   an assembling unit (30) provided with assembling drums (31) and conveying drums (32), for receiving the segments (A, B, C, D) from the feeding modules (20) and forming a group (G1) of the segments,
   a first wrapping module (40) for feeding a section of a first wrapping material (W1) and wrapping a group (G2) of the segments (A, B, C, D) pushed together so as to form a multi-segment rod (R),
   a cutting unit (50) for cutting the formed rod (R) into half multi-segment rods (R1, R2),
   an additional feeding module (70) as in any of claims 1 to 7 for cutting an additional rod (ME) and feeding additional segments (E) between the half multi-segment rods (R1, R2),
   a second wrapping module (80) for feeding a section of a second wrapping material (W2) and wrapping two half multi-segment rods (R1, R2) and the additional segment (E).

9. A method of manufacturing multi-segment articles comprising steps wherein,

   in feeding modules (20),

   rods (MA, MB, MC, MD) are fed from the hopper (21) for storing the rods (MA, MB, MC, MD), by means of the receiving drum (22) for receiving the rods (MA, MB, MC, MD),
   the rods (MA, MB, MC, MD) are cut into segments (A, B, C, D) by means of a cutting head (24), situated at the conveying drum (23), for cutting the rods (MA, MB, MC, MD) into individual segments (A, B, C, D),
   the segments (A, B, C, D) are fed to an assembling unit (30), via a shifting drum (25) for varying the mutual position of the segments (A, B, C, D) and an aligning drum (26) for forming at least one stream of the segments (A, B, C, D), then

segment groups (G1) are formed in the assembling unit (30) provided with assembling drums (31) and conveying drums (32) for receiving the segments (A, B, C, D) from the feeding modules (20),
the segments (A, B, C, D) are pushed together in group (G1) so that the segments (A, B, C, D) are in contact with one another,
in a first wrapping module (40), a section of a first wrapping material (W1) is fed and a group (G2) of the segments (A, B, C, D) pushed together is wrapped whereby the multi-segment rod (R) is formed, whereas by means of the conveying drum (44) the groups of the segments (A, B, C, D) are received and the groups (G2) of the segments (A, B, C, D) pushed together are conveyed along with a section of the first wrapping material (W1), and then the groups (G2) of the segments (A, B, C, D) pushed together are wrapped with the section of the first wrapping material (W1),
in the cutting unit (50), the formed multi-segment rod (R) is cut into half multi-segment rods (R1, R2),
in an additional feeding module (70) for cutting an additional rod (ME) and feeding additional segments (E) between the half multi-segment rods (R1, R2):

the rods (ME) are received from the hopper (71),
the rods (ME) are conveyed by means of a conveying drum (73), then
the cutting head (74) cuts the rods into individual segments, the cutting head (74) being situated at the conveying drum (73),
the mutual position of the segments (E) is varied by means of a shifting drum (75), then
at least one stream of the segments (E) is formed by means of an aligning drum (76), and then
sections of a second wrapping material (W2) are fed and the two half multi-segment rods (R1, R2) and the additional segment (E) are wrapped with a section of the second wrapping material (W2) by means of a second wrapping unit (80).

10. The method as in claim 9, further comprising the step wherein an empty flute (28') on the drum (22) is identified, and once the empty flute (28') on the receiving drum (22) has been identified, the speed (ω1) of the receiving drum (22) is increased relative to the speed (ω2) of the conveying drum (23) so that at the point of transfer (X) of the rod (MA) into the flute (29) of the conveying drum (23), there is another filled flute (28") of the receiving drum (22) and another empty flute (29') of the conveying drum (23).

11. The method as in claim 10, **characterised in that** the step of identifying an empty flute (28') is carried out by means of a filling sensor (91) for checking the presence of the rod (MA) in the flute (28).

12. The method as in claim 10 or 11, **characterised in that** the step of identifying the empty flute (28') is carried out by means of a defective rod (MA) rejection signal from a sensor (92) of quality control of the rod (MA).

13. The method as in any of claims 9 to 12, **characterised in that** the empty flute (28') is filled with a rod from the additional hopper (99) by means of a rotational inserting element (100) adapted to feed the rods (MA) individually into the flute (28).

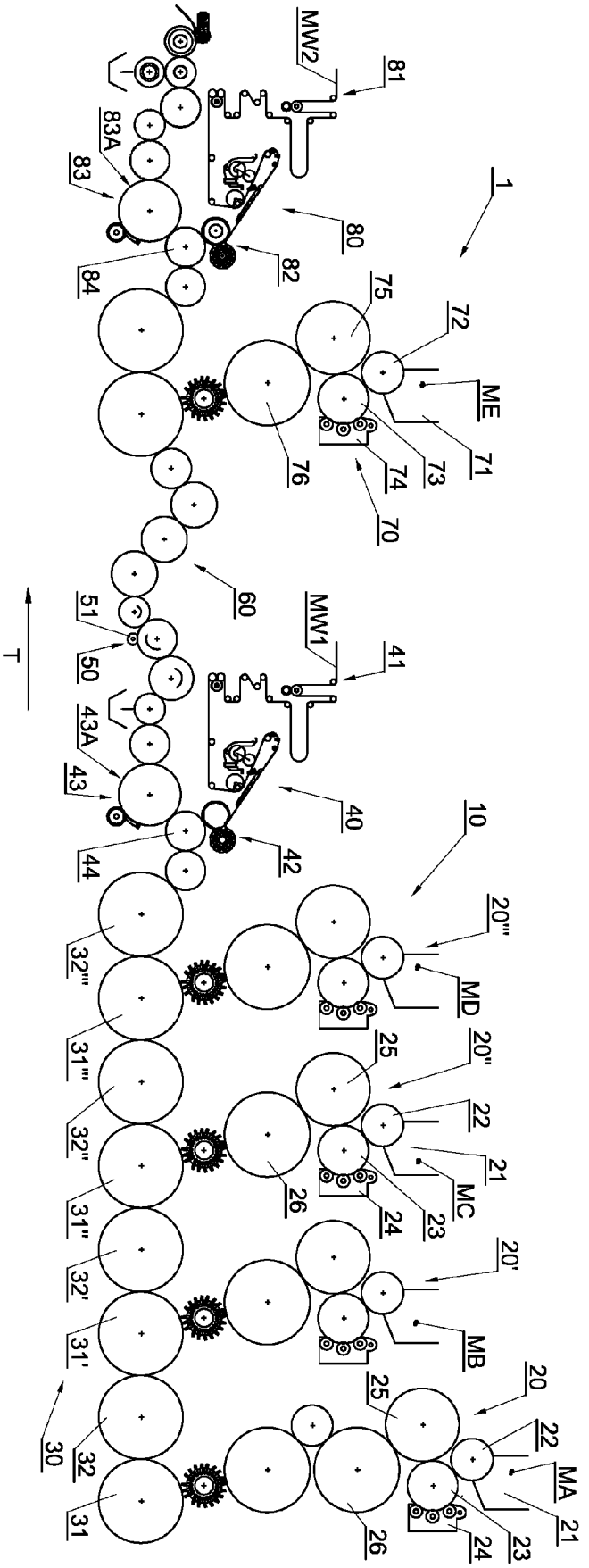
MW2
81
83A
83
80
1
84
82
75
72
ME
76
74
73
71
70
60
51
MW1
41
50
43A
43
40
10
44
42
20'''
MD
32'''
25
20''
31'''
22
32''
21
MC
26
24
23
20'
31''
32''
MB
31'
32'
25
20
30
22
MA
32
21
31
26
24
23
T

Fig. 1

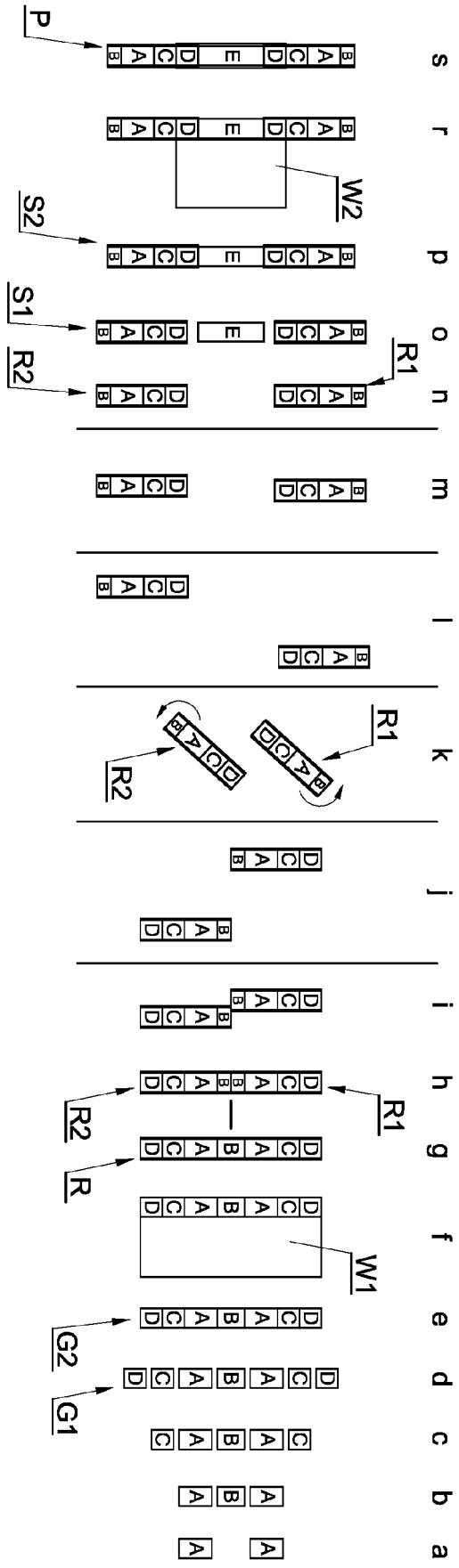

Fig. 2a

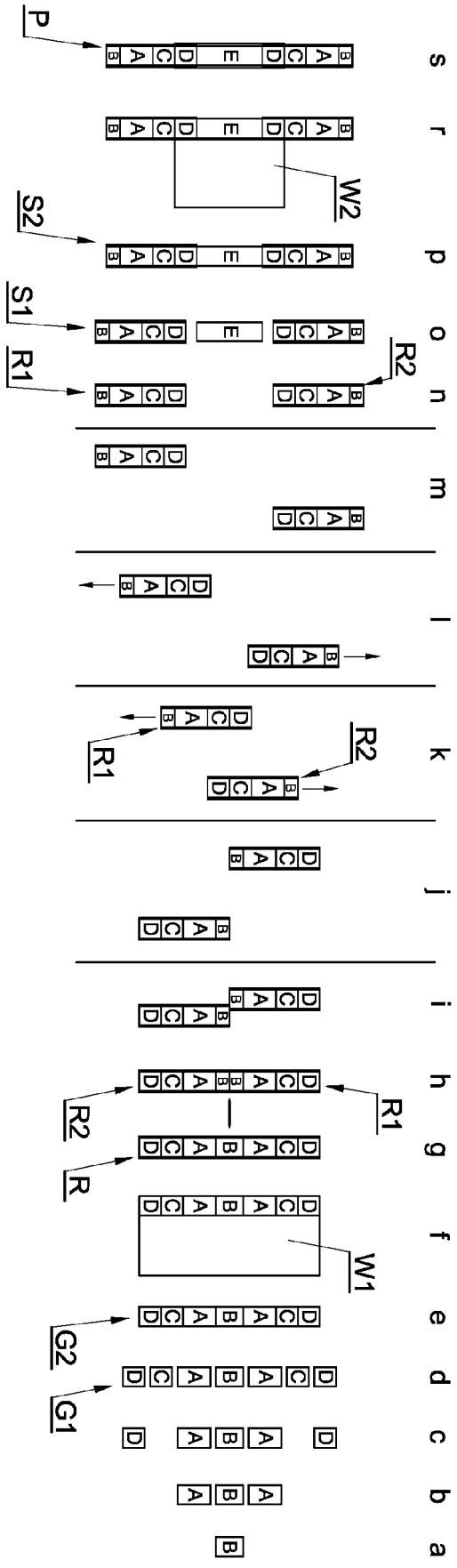

Fig. 2b

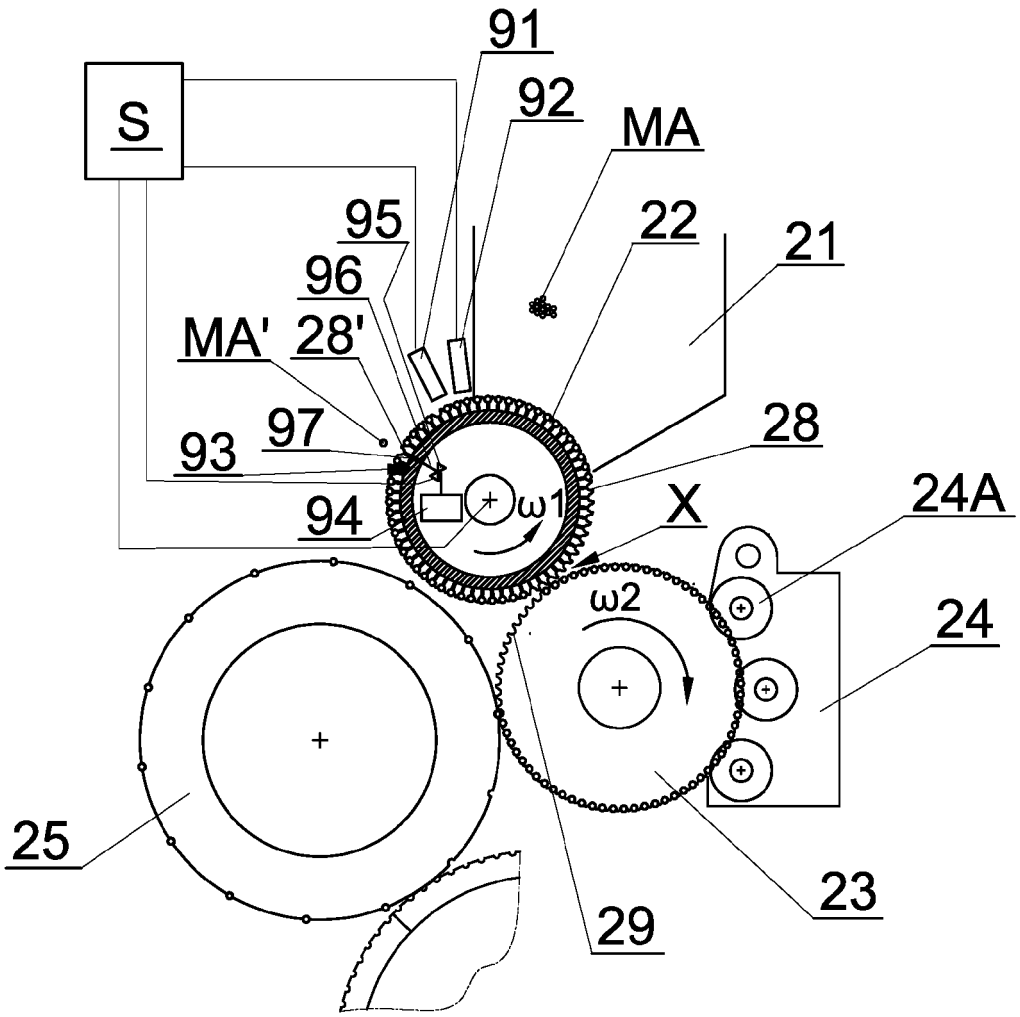

Fig. 3

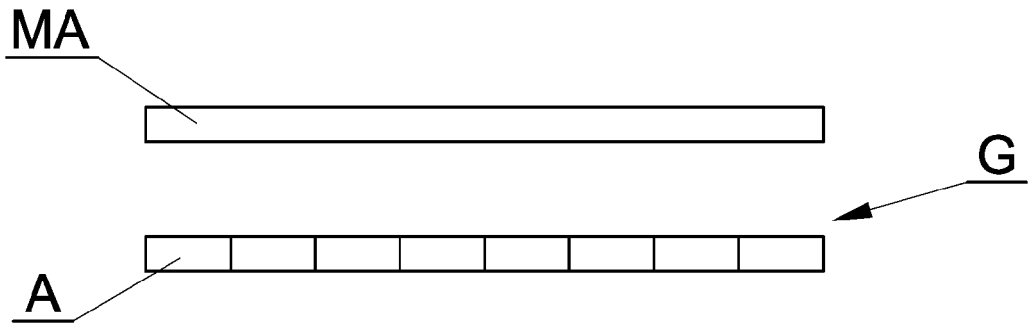

Fig. 3a

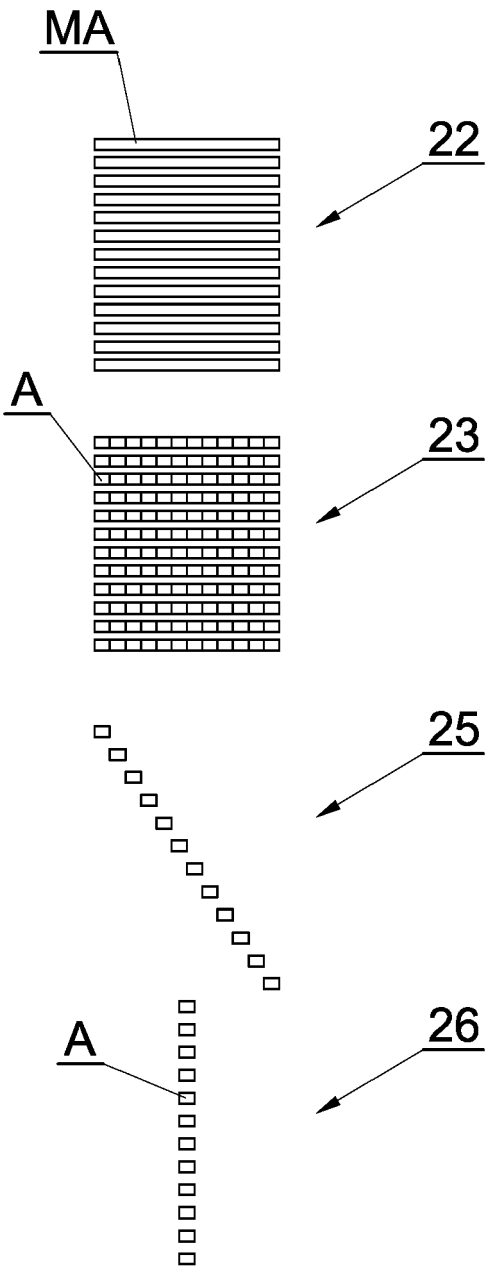

Fig. 3b

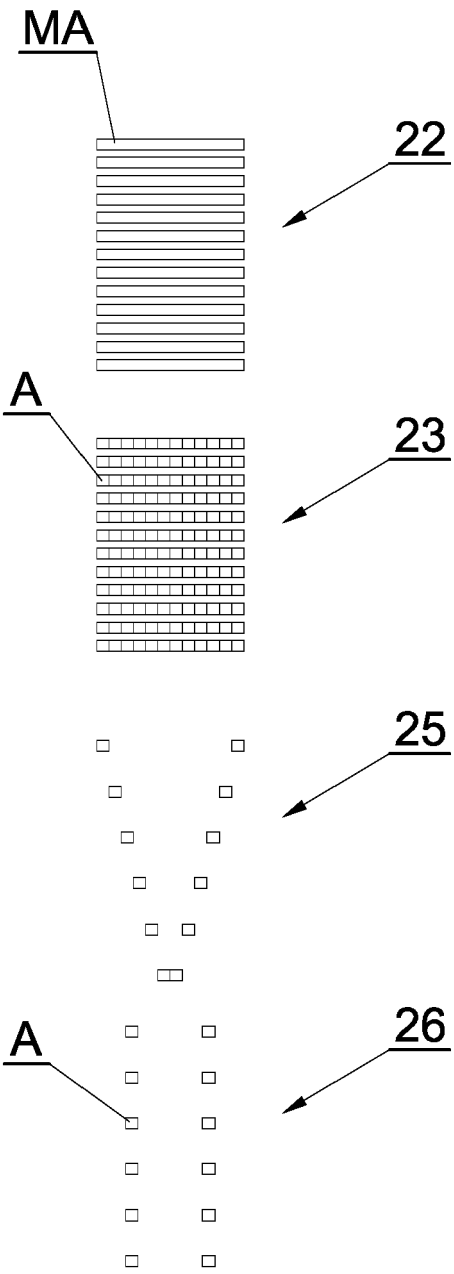

Fig. 3c

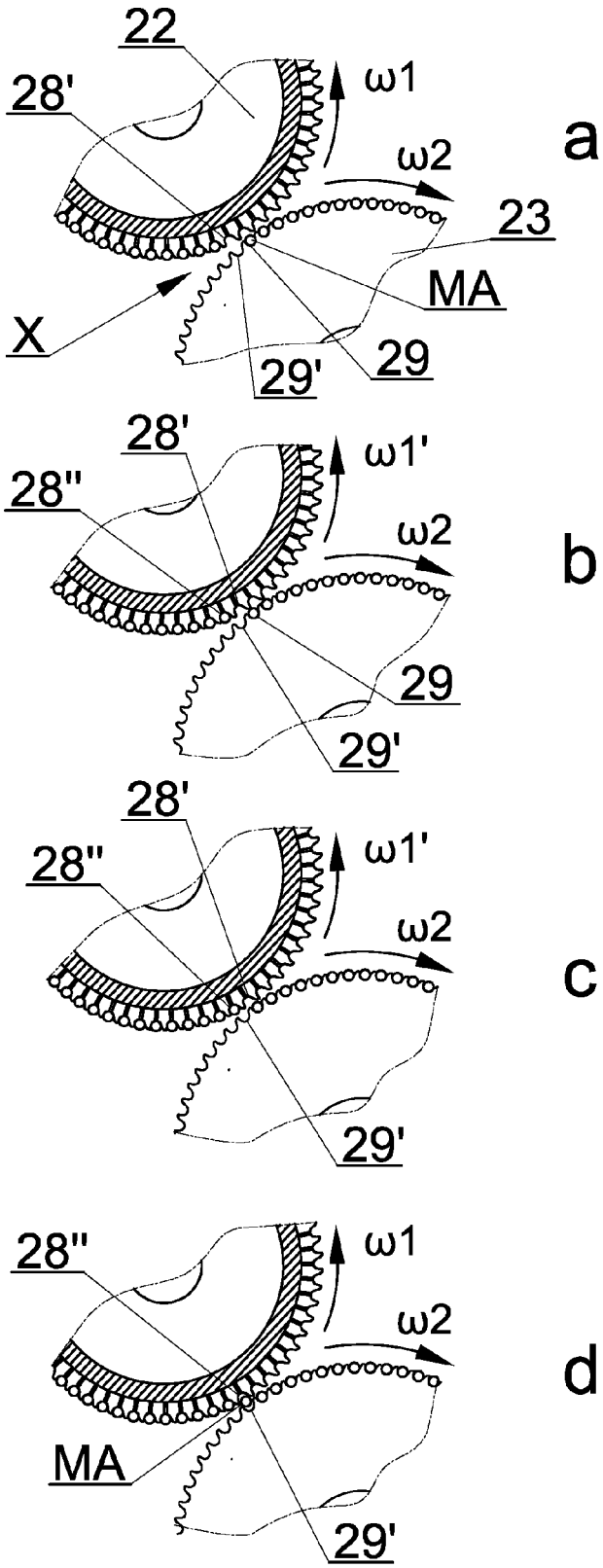
22
28'
ω1
ω2
a
23
MA
X
29'
29
28'
28"
ω1'
ω2
b
29
29'
28'
28"
ω1'
ω2
c
29'
28"
ω1
ω2
d
MA
29'

Fig. 4

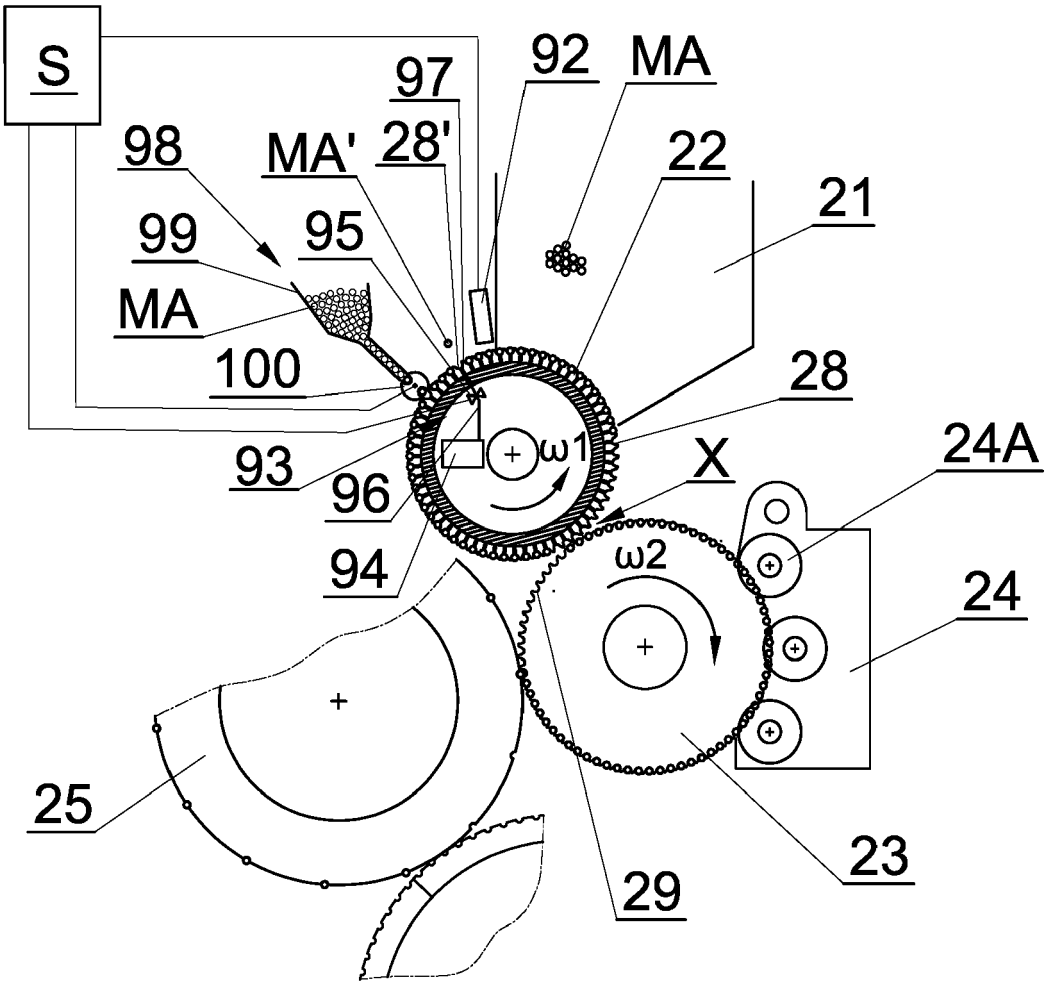
S
97
92
MA
98
MA'
28'
22
21
99
95
MA
100
28
93
ω1
X
24A
96
94
ω2
24
25
23
29

Fig. 5

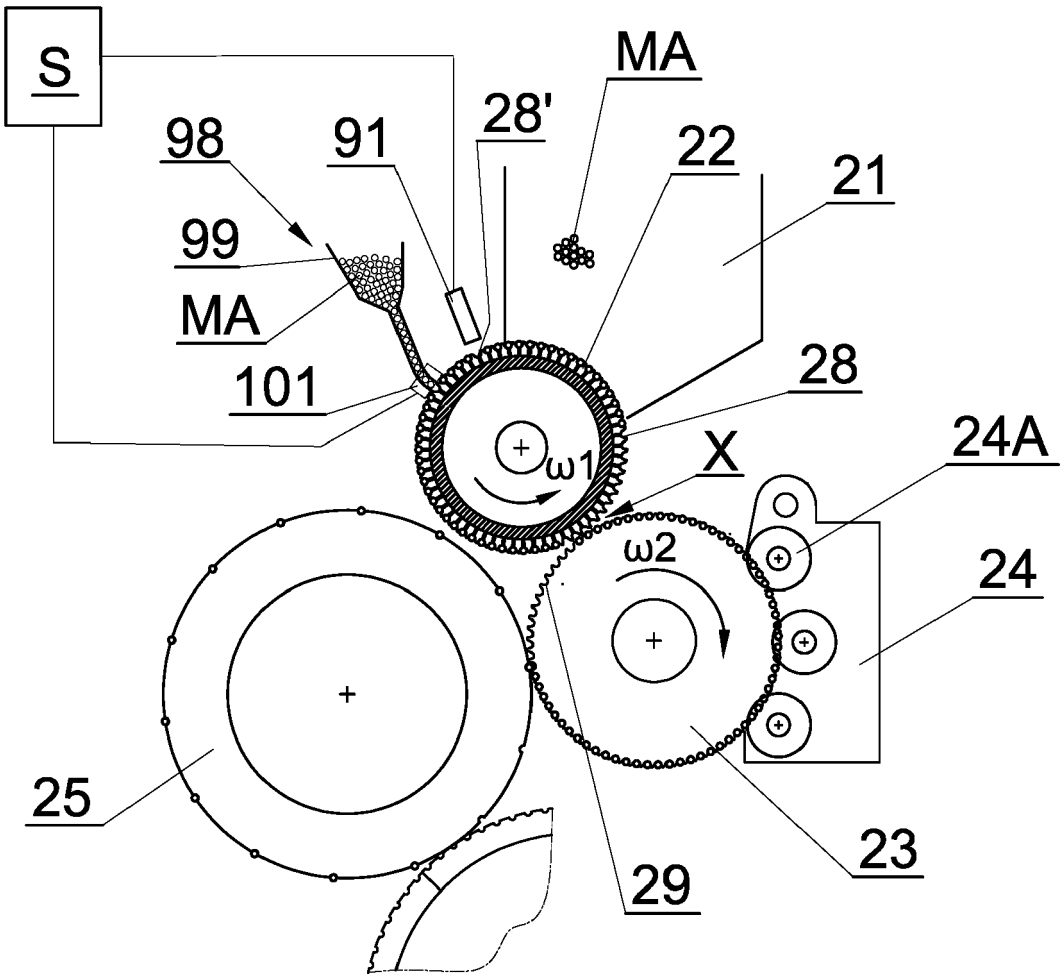

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 22 20 9345

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Y	* column 2, line 28 - column 3, line 41;	2,6,7	A24C5/01
A	claims; figures 1,2 *	5,8-13	A24D3/02 A24C5/32
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 May 2023	Marzano Monterosso

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X : particularly relevant if taken alone
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