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(54) METHOD AND APPARATUS FOR SEPARATING AND INSERTING OBJECTS INTO A MATERIAL ROD OF THE TOBACCO PROCESSING INDUSTRY

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(57) **ABSTRACT**

Method and apparatus for separating and inserting objects into at least one material rod of tobacco-processing industry. Method includes receiving objects from object supply volume into an annular groove on outer perimeter of accelerator wheel rotating around an axis of rotation, supplying annular groove with suction air to hold objects in annular groove, accelerating objects in a course of the rotation of accelerator wheel, conveying objects to a take-over device having discrete object receptacles for objects, receiving at least some of objects in a receiving section along a conveying path of objects in object receptacles of take-over device, conveying, downstream of receiving station, objects in object receptacles, and inserting objects into material rod through one of take-over device or an insertion device arranged downstream in conveying direction of objects. Excess objects are discharged after leaving the receiving section and returned to the object supply volume.

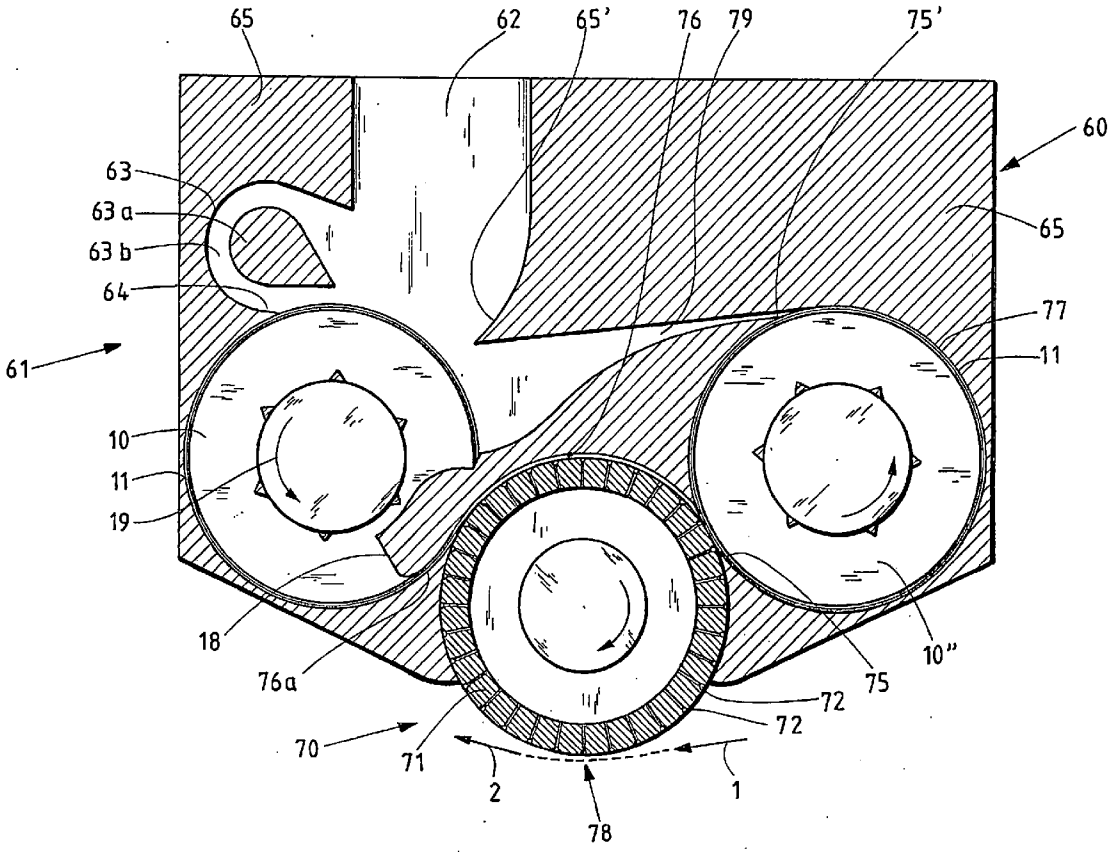
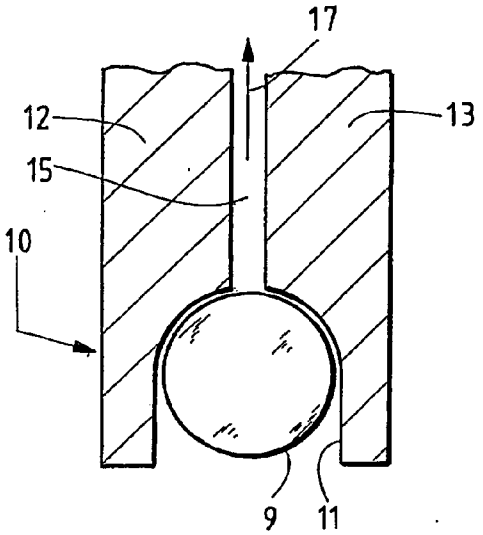


Fig.1 a)



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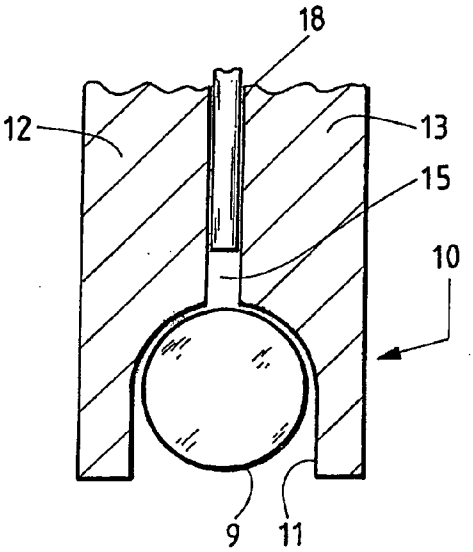
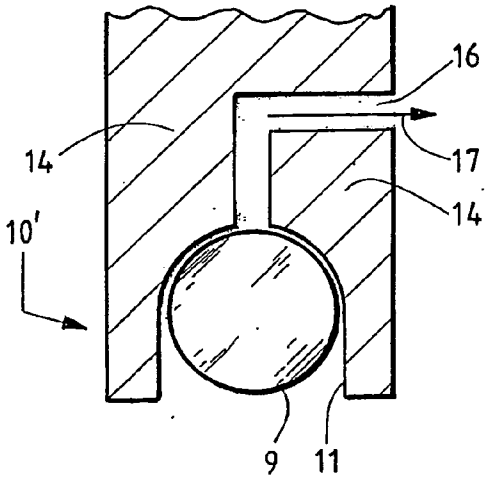


Fig. 2 a)



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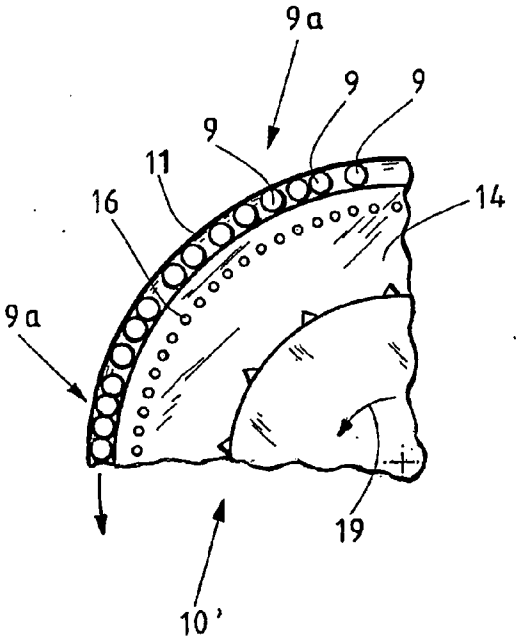

Fig. 3

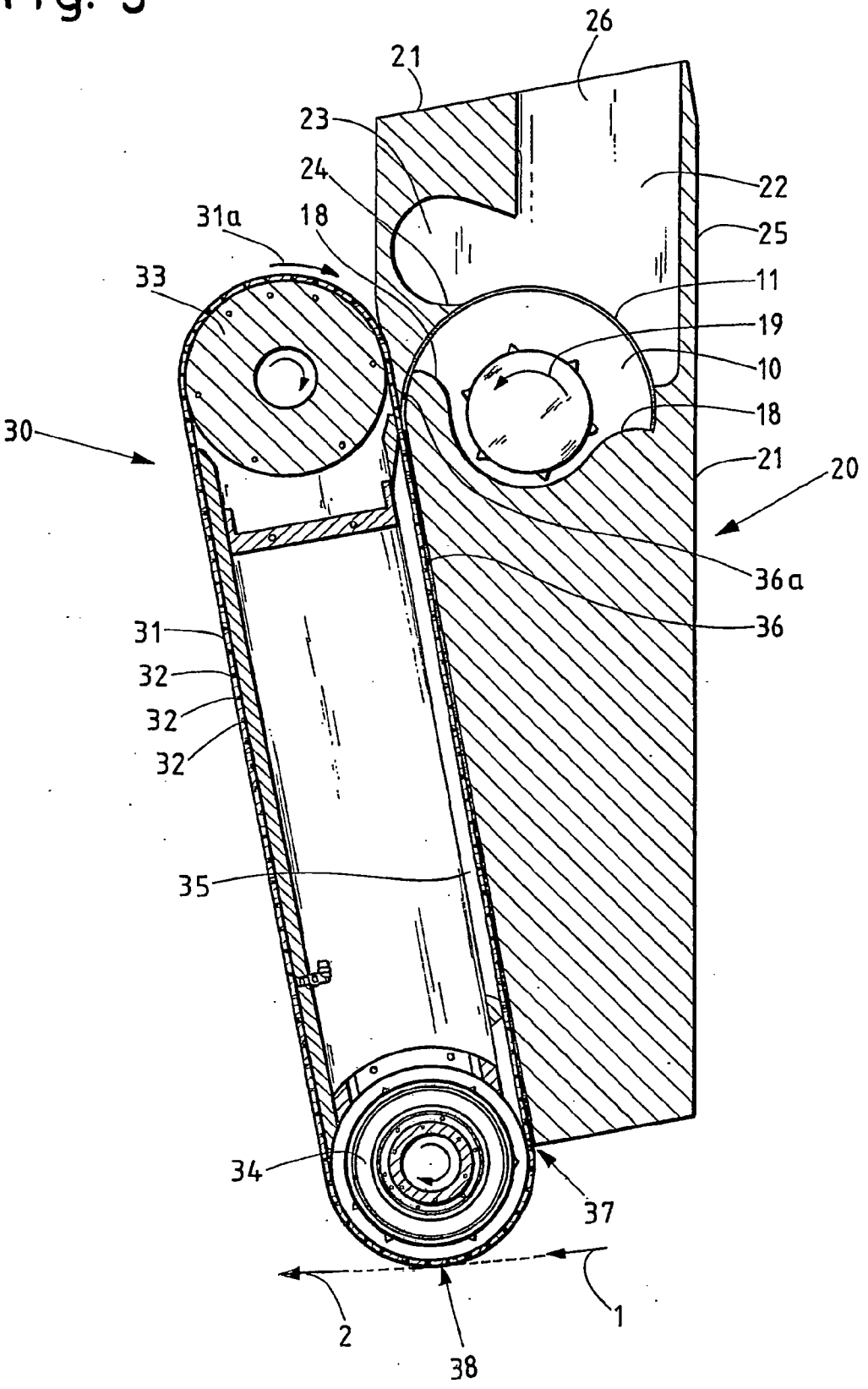
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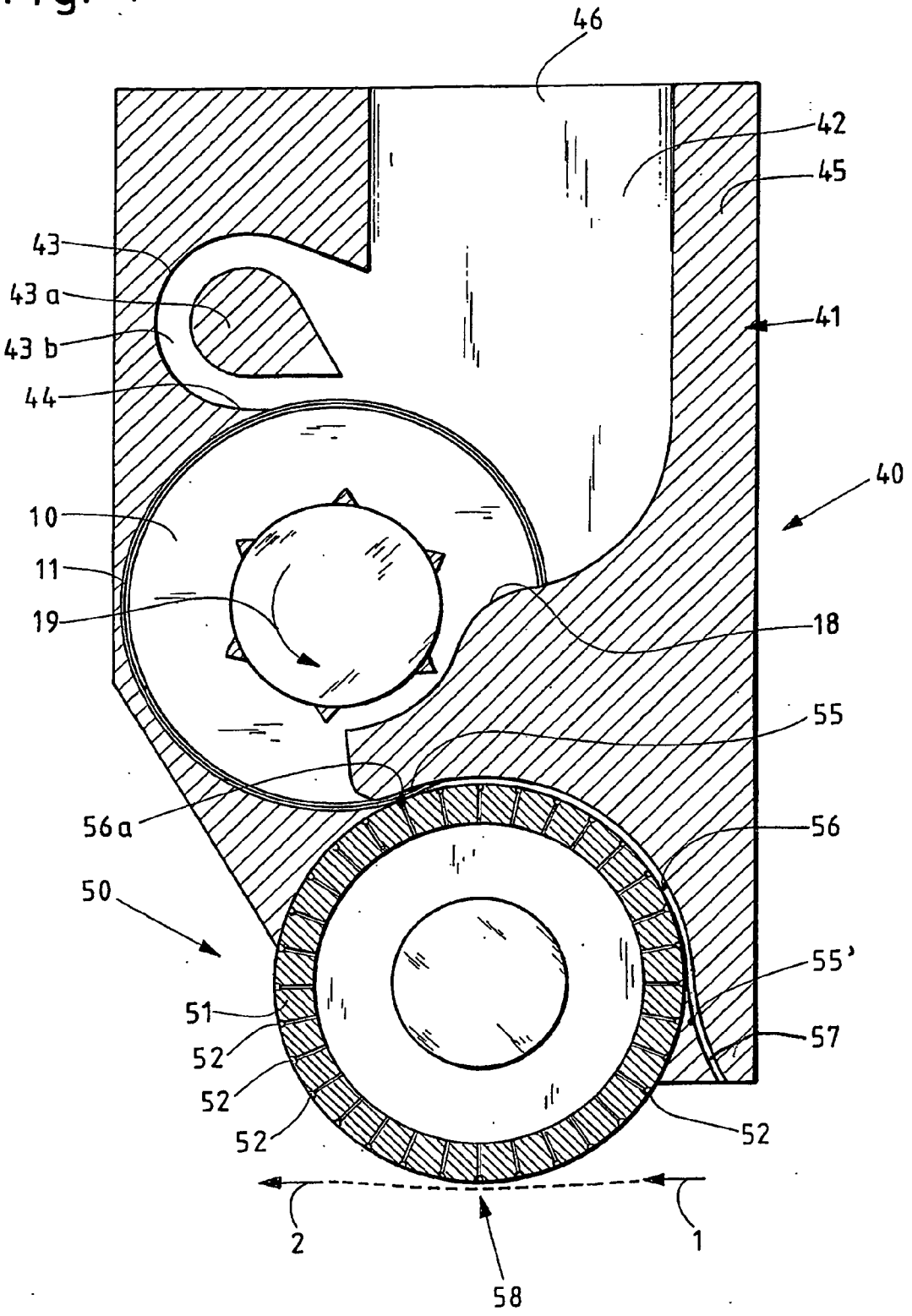
Fig. 4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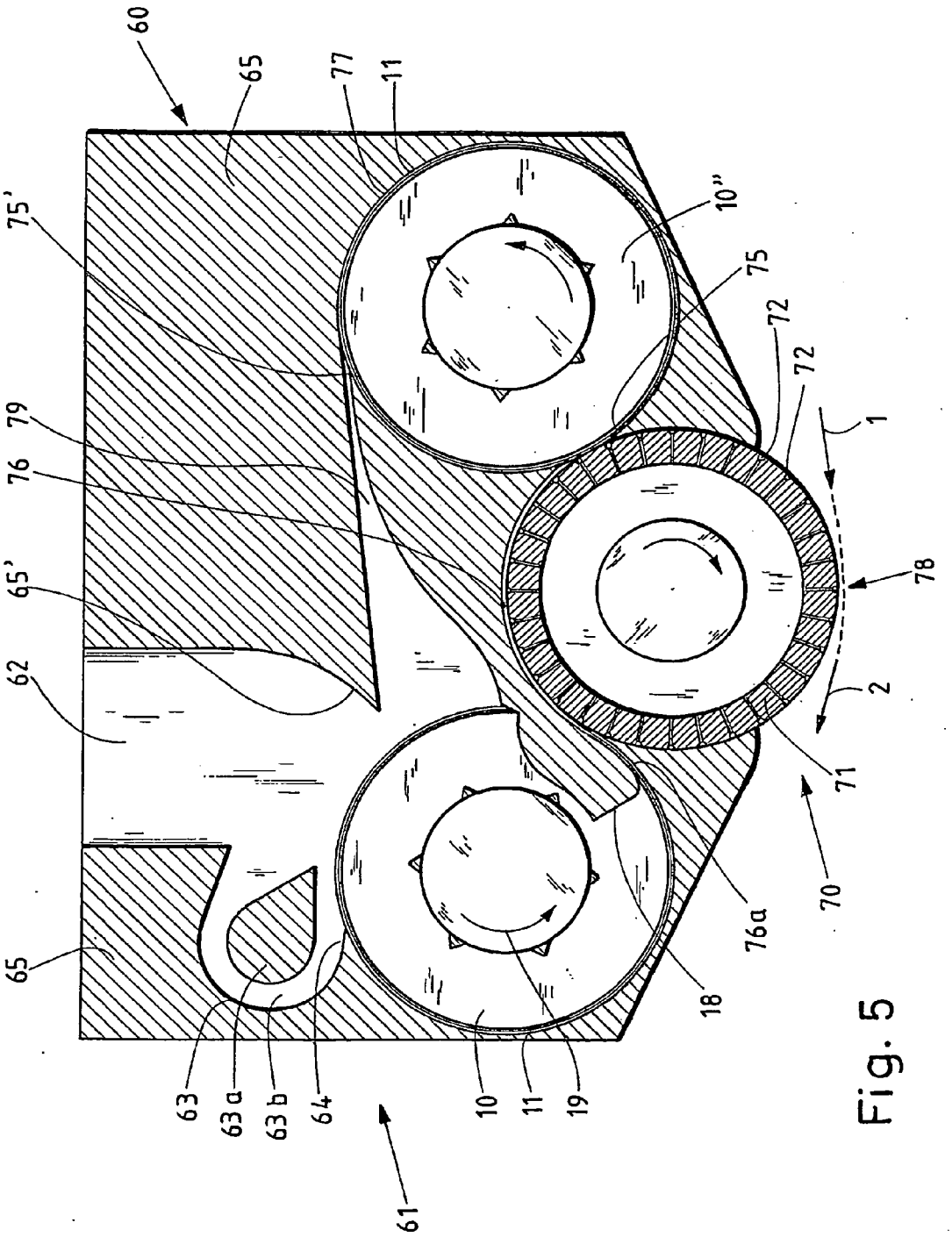
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Fig. 5

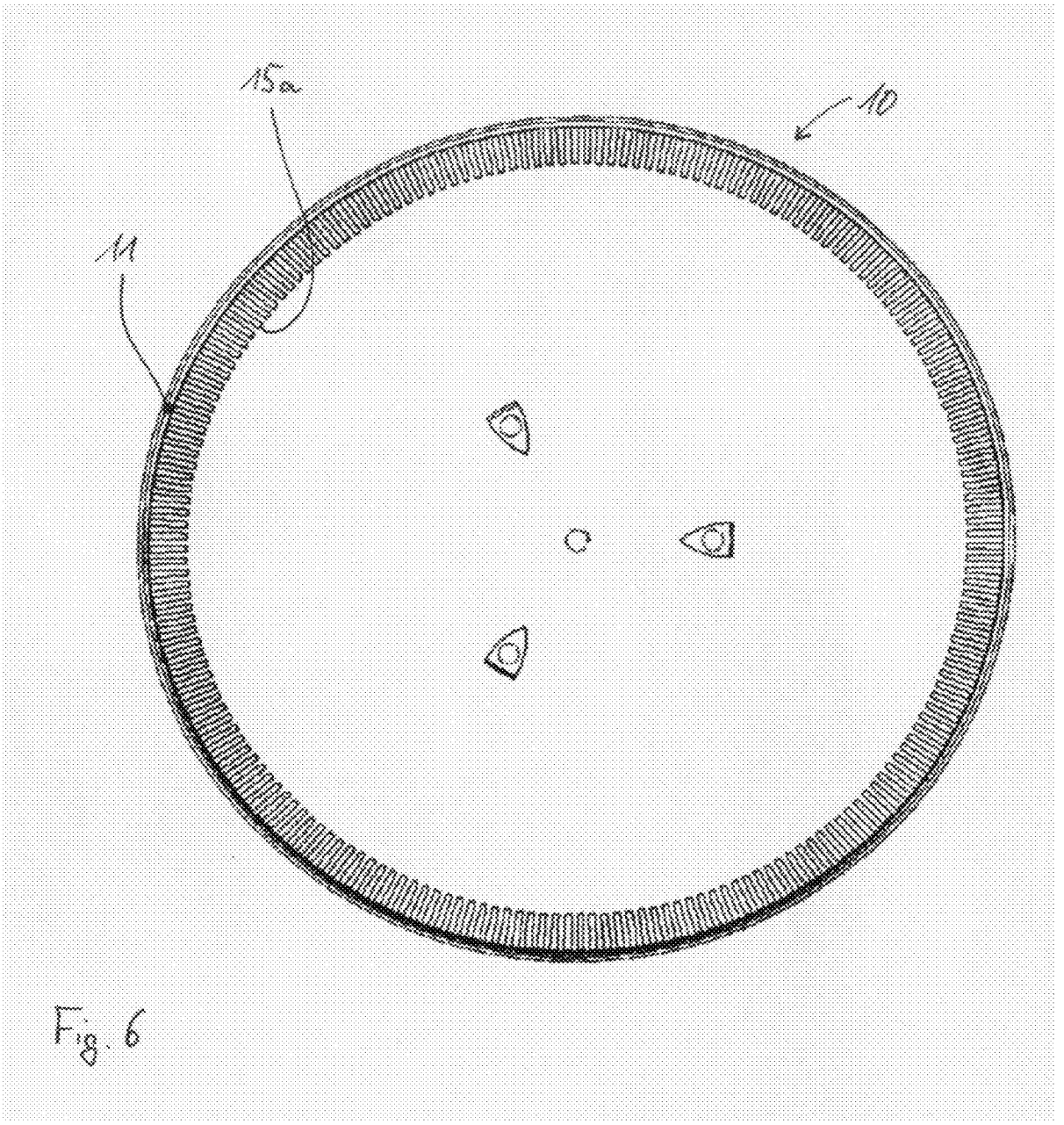

Fig. 6

METHOD AND APPARATUS FOR SEPARATING AND INSERTING OBJECTS INTO A MATERIAL ROD OF THE TOBACCO PROCESSING INDUSTRY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority under 35 U.S.C. §119(a) of German Patent Application No. 10 2011 085 534.3 filed Nov. 1, 2011 and of European Patent Application No. 12 183 281.0 filed Sep. 6, 2012, the disclosures of which are expressly incorporated by reference herein in their entireties.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates to a method for separating and inserting objects into at least one material rod of the tobacco-processing industry, in particular an endless filter rod. The invention also relates to an apparatus for separating and inserting objects into at least one material rod of the tobacco-processing industry, in particular an endless filter rod. The apparatus includes an object supply volume and a take-over device with discrete object receptacles for objects, such that a receiving section along the conveying path of the objects is arranged on the take-over device for receiving the objects in the object receptacles. The take-over device is designed for inserting objects into the material rod or additionally includes an insertion apparatus for inserting objects into the material rod, which is arranged directly or indirectly in the conveying direction of the objects downstream from the take-over device. Further, the invention relates to a machine of the tobacco-processing industry, in particular rod maker, as well as a use.

[0004] Accordingly, the invention relates to the production of a material rod, in particular an endless tobacco rod or endless filter rod, for rod-like articles of the tobacco-processing industry, in particular for filter cigarettes. The initially endless tobacco rod or endless filter rod is cut into individual tobacco rods or respectively filter rods after its production. The endless filter rod or respectively the cut filter rods or tobacco rods contain as a major component one or more objects, which impact the smoke or filter properties.

[0005] 2. Discussion of Background Information

[0006] In the case of filter rods or respectively an endless filter rod, the objects are in particular capsules with a solid cover, which are filled with a liquid. In such cases, the liquid normally contains flavor or scent additives, for example menthol. For use, a smoker breaks the capsule before smoking by pressing on the filter and then lights the cigarette. The liquid is released through the pressure on the capsule in the filter so that the aroma of the liquid unfolds. This procedure offers a particularly intensive or fresh taste sensation. Corresponding capsules normally have a diameter of approx. 3 to 3.5 mm, but can also be smaller.

[0007] Alternatively, hard objects can also be used within the framework of the invention, also smaller or larger particles, for example balls or cylindrical objects made of active charcoal, extrudates or other filter materials or additives.

[0008] In accordance with International Publication No. WO 2005/032286 A2, the disclosure of which is expressly incorporated by reference in its entirety, a generic technology comprises an insertion apparatus for capsules into a filter tow strip with a rotating insertion wheel. On its perimeter, the insertion wheel has receptacles for capsules, in which the capsules are held with suction air after insertion. During a further rotation of the insertion wheel, the perimeter of the insertion wheel penetrates continuously into the filter tow strip. In this instance, as soon as a capsule enters the filter tow strip, the suction air is switched off and the capsule is thereby placed in the filter tow strip so as to be further transported with the filter tow strip. At the location of the insertion wheel, the filter tow strip mainly receives the shape of a "U", so that the insertion wheel penetrates into the middle recess or respectively into the channel of the "U". This is followed by the formation of an endless filter rod, in which the filter tow strip is closed, sealed and wrapped with a strip of plugwrap.

[0009] The conveyance of a filter tow strip and an endless filter rod formed from it in an endless filter rod machine takes place continuously. The production speed and the conveying speed of the filter tow strip and of the endless filter rod formed from it are thereby restricted by the maximum speed of the insertion apparatus for objects to be placed in the endless filter rod. This maximum speed is currently approx. 100 m/min. The production speed is thus considerably lower than for conventional endless filter rods, into which no capsules are placed.

[0010] This is due to the fact that the speed differential between the insertion wheel and the capsules is too large directly before being received by the insertion wheel. Either each capsule does not find a receiving chamber in the insertion wheel or a capsule is destroyed because it has not yet disappeared entirely in the receiving chamber and is crushed on the reservoir wall.

[0011] Furthermore, during startup with known systems, the filter rods populated with capsules must be ejected until the endless filter rod and the insertion wheel are synchronized.

[0012] Further known systems thus guide previously separated objects to the respective holes of the insertion wheel. The insertion speed is hereby restricted in that the separation mechanisms arrive at its dynamic limit and the objects are destroyed during transfer to an insertion wheel.

[0013] An improved method and an improved apparatus for inserting objects into a material rod of the tobacco-processing industry are disclosed in the German patent application No. DE 10 2011 017 615.2 of the Applicant, the disclosure content of which is expressly incorporated by reference herein in its entirety. In it, objects are removed from an object supply and accelerated by ring nozzles in the conveying direction in a receiving section into a straight section of an insertion belt conveyed via return pulleys with receptacles for the objects arranged in at least one row one after another, in order to reduce a speed differential between the receptacles of the insertion belt and the objects. The objects are received in the receptacles along the receiving section, are held in the receptacles of the insertion belt by suction air and conveyed to an insertion position on the material rod and are inserted into the material rod at the insertion position. In this manner, the speed differential between the objects and the object receptacles is reduced in the insertion belt so that the objects are received in a gentler manner than previously possible into the object receptacles.

SUMMARY OF THE EMBODIMENTS

[0014] With respect to this state of the art, embodiments of the present invention provide an alternative process and

device for separating and inserting objects into a material rod of the tobacco-processing industry, with which a gentle and efficient separation of objects is possible.

[0015] Accordingly, a method is provided for separating and inserting objects into at least one material rod of the tobacco-processing industry, in particular an endless filter rod. In embodiments, objects are received from an object supply volume into an annular groove on the outer perimeter of an accelerator wheel rotating around an axis of rotation, and the groove is supplied with suction air. The objects, which are held by the suction air in the annular groove of the accelerator wheel, are accelerated in the course of the rotation of the accelerator wheel and are conveyed to a take-over device, which has discrete object receptacles for the objects. Some of the objects in a receiving section along the conveying path of the objects are received in the object receptacles of the take-over device, are conveyed further in the object receptacles after leaving the receiving section and are then inserted into a material rod by the take-over device or an insertion device arranged downstream in the conveying direction of the objects. The objects which were not received in an object receptacle of the take-over device in the receiving section are discharged after leaving the receiving section and/or are returned to the object supply volume.

[0016] The use of a rotating accelerator wheel with an annular groove on the outer perimeter on which suction air is applied at least in sections has the advantage that the objects can enter directly from the object supply volume into the fitting circumferential annular groove, are movably held by suction air moving within the annular groove and are thus conveyed along with and accelerated in a gentle manner by the accelerator wheel. With the method according to the invention, rod production speeds are achievable for rods with inserted objects, which are comparable with those for material rods without inserted objects.

[0017] Since the annular groove is circumferential, there are no transverse edges in the annular groove, on which the objects can be damaged. Suction air is applied on the annular groove so that the objects in the annular groove can be suctioned and thus conveyed along by the rotating accelerator wheel. During rotation, the speed of the objects in the annular groove adapts to the circumferential speed of the accelerator wheel. In this manner, the entire section of the annular groove, which is located at one point in time in the object supply volume or in connection with the object supply volume, can be filled with objects. This also means that an excess of objects in the annular groove is conveyed in the direction of the take-over device, i.e., more objects are conveyed to the take-over device than there are object receptacles available on the take-over device. This increases the probability that each object receptacle of the take-over device is filled with an object and minimizes the probability that object receptacles of the take-over device remain empty, which leads in the further progression of the method to a rejection of accordingly unfilled filter rods or cigarette rods.

[0018] The objects form a more or less closed object chain or object train, i.e. the objects are in touching contact with each other, wherein holes can also occur between objects due to the dynamic process. These object chains are conveyed in a channel. Furthermore, due to the formation of object chains, more objects are conveyed past the take-over device than can be received by the take-over device. The excess objects, which were not received, are caught and/or returned to the object supply volume.

[0019] The objects are preferably accelerated on the accelerator wheel to a speed, which exceeds the conveying speed of the take-over device. A minimum speed can also be set according to the invention as long as the speed differential is suitable in order to fill the object receptacles of the take-over device with objects. The differential speed of the accelerator wheel, with respect to the conveying speed of the take-over device, is preferably between −30% and +30%, in particular preferably between −15% and +15%.

[0020] In the case of the method, an excess of objects is advantageously conveyed to the take-over device. This increases the probability that each object receptacle of the take-over device is filled with an object.

[0021] It is provided in a preferred further embodiment that the excess objects are returned to the object supply volume by a second accelerator wheel with an annular groove to which suction air is supplied, which is arranged downstream of the take-over device. In this manner, the principle of acceleration according to the invention by an accelerator wheel with an annular groove on which suction air is applied is used twice. This results in a circulation of objects, which are conveyed to the take-over device, in particular in excess.

[0022] In the case of the accelerator wheel, the suction air is advantageously switched off along a portion of the perimeter in the direction of rotation, in particular between a transfer point to the take-over device and a point where the annular groove enters into the object supply volume. In this manner, suction air is saved and objects are prevented from being held back under the effect of the suction air on the accelerator wheel during transfer from the accelerator wheel to the take-over device. This measure improves the trouble-free progression of the separation.

[0023] In embodiments of the invention, an apparatus is provided for separating and inserting objects into at least one material rod of the tobacco-processing industry, in particular an endless filter rod. The apparatus includes an object supply volume and a take-over device with discrete object receptacles for objects. A receiving section along the conveying path of the objects is arranged on the take-over device for receiving the objects in the object receptacles, and the take-over device is designed to insert objects into the material rod or additionally an insertion device for inserting objects into the material rod is included and arranged directly or indirectly in the conveying direction of the objects downstream from the take-over device. A rotating or rotatable accelerator wheel is arranged between the object supply volume and the take-over device, which has an annular groove on which suction air is applied or appliable on its perimeter, the width of which is not or is only slightly greater than a diameter of the objects.

[0024] As in the case of the previously described method according to the invention, the apparatus according to the invention is also based on the gentle acceleration principle of the accelerator wheel with the annular groove to which suction air is applied. The effect occurring in previously known systems, i.e., that not every capsule finds a receiving chamber or respectively object receptacle in the insertion wheel or that objects are destroyed because they have not yet disappeared entirely in the object receptacle and are crushed on the wall of the object supply, which is caused by the fact that objects being conveyed with an undefined speed to an insertion wheel with discrete object receptacles have a large speed differential with the insertion wheel directly or indirectly in front of the

receptacles, is avoided. Thus, with the apparatus according to the invention, the restricted production speed of such systems is exceeded.

[0025] In accordance with the present method according to the invention and the apparatus according to the invention, the objects are thus removed from an object supply volume by an accelerator wheel and are accelerated gently almost to rod speed. The pre-accelerated objects are conveyed past a take-over device, which is equipped with suitable object receptacles. The object chain already described above forms in the annular groove of the accelerator wheel.

[0026] The depth of the annular groove preferably matches a diameter of an object. The objects are thereby protected inside the annular groove on the accelerator wheel.

[0027] Furthermore, the width of the object supply volume corresponds with a diameter of an object, wherein in particular the side walls of the object supply volume are flush with the side walls of the annular groove. In this manner, the objects under the effect of the suction air and in particular gravity make their way without further hindrances directly into the annular groove of the accelerator wheel. In this manner, a gentle handling of the objects is achieved.

[0028] The take-over device is advantageously designed as a take-over belt or insertion belt or as a take-over wheel or insertion wheel. The respective take-over belt or insertion belt, take-over wheel or insertion wheel each has discrete object receptacles, in which in particular the objects are completely received.

[0029] In an advantageous embodiment, a second accelerator wheel, by which excess objects are returnable to the object supply volume, is arranged downstream of the take-over device in the conveying direction of the objects. This second accelerator wheel receives the objects not received from the take-over device and accelerates them a second time. These objects make their way back to the object supply volume after acceleration.

[0030] The accelerator wheel or wheels preferably has or have two disks, between which is or are arranged a gap and/or radially aligned or radially tilted channels for suction air. The disks each have on their perimeter a lateral part of the annular groove, and in particular a fixed air control body engaging in the gap between the disks is arranged to switch off the suction air and/or for removing the objects from the annular groove. By way of the embodiment with the two disks, a supply of the gap in the annular groove with suction air over the entire length of the annular groove is guaranteed. The suction air is for example insertable in the center of the accelerator wheel. If channels for the suction air, which lead inward radially or with a tilt with respect to the radial, are arranged at least in one area adjacent to the annular groove, the pickup behavior of the objects is advantageously improved, among other things, in that a swirling of the suction air in the gap and differences in the suction and holding force caused by it in the circumferential direction are prevented. A gap, via which all channels are supplied with vacuum or respectively vacuum pressure, can be connected to the channels on the inside.

[0031] In an alternative embodiment, which can also be used in combination with another accelerator wheel of the first embodiment, it is provided that the accelerator wheel has openings on one or both lateral surfaces, which are flush with a corresponding, fixed, in particular annular-section-shaped suction air nozzle and are connected with the annular groove inside the accelerator wheel. In this manner, the suction air is supplied from the side via openings, which are designed like a row of small openings or long-hole-shaped openings with the same or varying lengths. The expansion of the suction air nozzle is decisive for determining in which section suction air is supplied and in which section no suction air is supplied. These lateral openings open into a traversing channel, which is connected transversely with the annular groove so that an even application of suction air on the annular groove is also guaranteed.

[0032] In the region of the exit of the accelerator wheel out of the object supply volume, a side wall of the object supply volume is preferably designed wedge-shaped in sections for stripping off objects taken along outside the annular groove. The side wall on the side of the wedge-shaped section facing away from the accelerator wheel has a recess, by which the stripped objects are steered or are steerable back into the object supply volume. In particular the recess in its center has an island-like blocked area so that a bent channel for the objects is formed in the recess around the blocked area. The recess serves to return those objects into the object supply volume, which were pulled by the accelerator wheel and also accelerated, but which did not enter into the annular groove.

[0033] The separation of these objects from the objects inside the annular groove takes place through the wedge-shaped section of the side wall, which is also called a stripping wedge, and which causes a gentle direction change for these objects. The recess has a bent wall, which reverses the direction of movement of the objects rolling-up or sliding on it, so that they are steered back to the object supply volume. If an island-like blocked area is also designed inside the recess so that a bent channel is formed for the objects in the recess, an even smoother flow of objects is also guaranteed since they are returned to the object supply volume in a continuous object flow with an even better defined direction. In particular, the cross-section of the channel is mainly constant in the progression of the channel so that no jams can form.

[0034] It is provided in an advantageous further embodiment that the accelerator wheel is arranged between the object supply volume and a transfer position to the take-over device inside a housing, which is arranged tight on the circumference of the accelerator wheel such that objects cannot leave the annular groove. In this manner, the so-called object chains are also retained in the further progression of conveyance, which leads to the effective supply of object receptacles of the take-over device with objects.

[0035] The speed of the accelerator wheel(s) is preferably regulatable. In this manner, the differential speed between the accelerator wheel and the take-over device can be individually adjusted for different production speeds, object types etc. in order to guarantee a particularly efficient process.

[0036] Further, embodiments of the invention are directed to a machine of the tobacco-processing industry, in particular a rod maker, in particular a filter rod maker, with one or more previously described apparatus according to the invention for one or more material rods, in particular endless filter rods.

[0037] Moreover, embodiments of the invention are directed to a use of an accelerator wheel with on its perimeter an annular groove suppliable with suction air for accelerating objects out of an object supply volume and for conveying an excess of objects, in particular under the formation of an object chain, to a take-over device with discrete receptacles for objects. This use of an accelerator wheel also has the described advantages, namely, that in particular an object chain, that is an excess of objects with respect to the available

object receptacles, is produced on the take-over device and is conveyable to the take-over device with a differential speed.

[0038] The characteristics, advantages and properties named for the individual invention objects, i.e., the method, the apparatus, the machine and the use, also apply without restriction to the respective other invention objects, which relate to each other.

[0039] Further, characteristics of the invention will become apparent from the description of the embodiments according to the invention together with the claims and the included drawings. Embodiments according to the invention can fulfill individual characteristics or a combination of several characteristics.

[0040] Embodiments of the invention are directed to a method for separating and inserting objects into at least one material rod of the tobacco-processing industry. The method includes receiving objects from an object supply volume into an annular groove on an outer perimeter of an accelerator wheel rotating around an axis of rotation, supplying the annular groove with suction air, whereby the objects are held in the annular groove, accelerating the objects in a course of the rotation of the accelerator wheel, conveying the objects to a take-over device having discrete object receptacles for the objects, receiving at least some of the objects in a receiving section along a conveying path of the objects in the object receptacles of the take-over device, conveying, downstream of the receiving station, the objects in the object receptacles, and inserting the objects into the material rod through one of the take-over device or an insertion device arranged downstream in the conveying direction of the objects. Excess objects, which were not received in the receiving section in an object receptacle, are at least one of discharged after leaving the receiving section and returned to the object supply volume.

[0041] According to embodiments, the at least one material rod of the tobacco-processing industry can be an endless filter rod.

[0042] In accordance with other embodiments of the invention, the objects on the accelerator wheel can be accelerated to a speed that exceeds a conveying speed of the take-over device.

[0043] According to still other embodiments, an excess of objects in relation to the receptacles is conveyed to the take-over device. Further, at least some of the excess objects are returned to the object supply volume via a second accelerator wheel coupled to the take-over device, the second accelerator wheel having an annular groove supplied with suction air.

[0044] In embodiments, the method can further include switching off the suction air along a portion of the perimeter of the accelerator wheel. The portion of the perimeter along which the suction air is switched off is arranged, in a direction of rotation, between a transfer point to the take-over device and a point where the annular groove penetrates into the object supply volume.

[0045] Embodiments of the instant invention are directed to an apparatus for separating and inserting objects into at least one material rod of the tobacco-processing industry. The apparatus includes an object supply volume, a take-over device comprising discrete object receptacles structured to receive the objects, a receiving section arranged on the take-over device and along a conveying path of the objects received in the object receptacles, at least one of the take-over device being structured and arrange to insert objects into the material rod or an insertion device is structured to insert objects into the material rod and arranged one of directly and indirectly in the conveying direction of the objects downstream from the take-over device, a rotating or rotatable accelerator wheel being structured and arranged between the object supply volume and the take-over device, the accelerator wheel having an annular groove on a perimeter to which suction air is applied or applicable. A width of the annular groove corresponds to a diameter of the objects.

[0046] According to embodiments, the at least one material rod of the tobacco-processing industry can be an endless filter rod and the width of the annular groove may be one of not greater than or only slightly greater than the diameter of the objects.

[0047] In accordance with other embodiments, a depth of the annular groove can match the diameter of the objects.

[0048] According to further embodiments of the invention, a width of the object supply volume corresponds with the diameter of the objects. The object supply volume may be defined in part by side walls arranged flush with side walls of the annular groove.

[0049] Further, the take-over device can include one of a take-over belt, an insertion belt, a take-over wheel or an insertion wheel.

[0050] According to still other embodiments, a second accelerator wheel can be arranged downstream of the take-over device in the conveying direction of the objects. The second accelerator may be structured and arranged to return excess objects to the object supply volume. The accelerator wheel and the second accelerator wheel may each comprise two disks arranged to form at least one of a gap, radially aligned channels or radially tilted channels for suction air, and the disks on their perimeters can have a lateral portion of the annular groove. The apparatus may also include a fixed air control body engaging in the gap between the disks that is structured and arranged for at least one of switching off the suction air and taking the objects out of the annular groove.

[0051] In still further embodiments, the accelerator wheel may include two disks arranged to form at least one of a gap, radially aligned channels or radially tilted channels for suction air, and the disks on their perimeters can have a lateral portion of the annular groove. The apparatus may further include a fixed air control body engaging in the gap between the disks that is structured and arranged for at least one of switching off the suction air and taking the objects out of the annular groove.

[0052] In other embodiments of the instant invention, the accelerator wheel can have openings on one or both side surfaces, which are flush with a corresponding, fixed, annular-section-shaped suction air nozzle and can be connected with the annular groove inside the accelerator wheel.

[0053] Moreover, the accelerator wheel can be arranged to extend into the object supply volume, and in a region of an exit of the accelerator wheel out of the object supply volume, a side wall of the object supply volume can form wedge-shaped sections for stripping off objects taken along outside of the annular groove. The side wall on the side of the wedge-shaped section facing away from the accelerator wheel may have a recess, by which the stripped objects are steered or are steerable back into the object supply volume. The recess in its center may have an island-like blocked area so that a bent channel for the objects is formed in the recess around the blocked area.

[0054] According to still further embodiments, the accelerator wheel can be arranged between the object supply vol-

ume and a transfer position to the take-over device in a housing that is arranged so tightly on the perimeter of the accelerator wheel so that objects cannot leave the annular groove.

[0055] In accordance with still other embodiments of the invention, a speed of the accelerator wheel may be regulatable.

[0056] In accordance with still yet other embodiments of the present invention, a rod maker machine of the tobacco-processing industry can include at least one of the above-described apparatus for making at least one endless filter rod.

[0057] Embodiments of the invention are directed to a method of operating an accelerator wheel having a perimeter with an annular groove. The method includes supplying suction air to discrete receptacles in the annular groove to receive objects from an object supply volume accelerating the objects from the object supply volume. and conveying more objects than the objects in the receptacles to a take-over device.

[0058] Other exemplary embodiments and advantages of the present invention may be ascertained by reviewing the present disclosure and the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0059] The present invention is further described in the detailed description which follows, in reference to the noted plurality of drawings by way of non-limiting examples of exemplary embodiments of the present invention, in which like reference numerals represent similar parts throughout the several views of the drawings, and wherein:

[0060] FIGS. **1***a* and **1***b* illustrate sectional representations through a first embodiment of an accelerator wheel according to the invention;

[0061] FIGS. **2***a* and **2***b* illustrate sectional representation and a side view of a second embodiment of an accelerator wheel according to the invention;

[0062] FIG. **3** schematically represents a first separating and inserting apparatus according to the invention;

[0063] FIG. **4** schematically represents a second embodiment of a separating and inserting apparatus according to the invention;

[0064] FIG. **5** schematically represents a third embodiment of a separating and inserting apparatus according to the invention; and

[0065] FIG. **6** schematically represents an accelerator wheel according to the invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0066] The particulars shown herein are by way of example and for purposes of illustrative discussion of the embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the present invention. In this regard, no attempt is made to show structural details of the present invention in more detail than is necessary for the fundamental understanding of the present invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the present invention may be embodied in practice.

[0067] FIG. **1** a shows schematically in one section a cross-sectional representation through an outer perimeter of an accelerator wheel **10** according to an exemplary embodiment of the invention. Accelerator wheel **10** has two disks **12**, **13** arranged to form a gap **15** that is supplied with suction air **17**. The outer perimeter of the two disks **12**, **13** of accelerator wheel **10** has on the respective insides a recess, which together form an annular groove **11** that forms a complete, circumferential seating for objects **9**.

[0068] As shown in FIG. **1***a*, the width and the depth of annular groove **11** mainly match the diameter of object **9**. Object **9** is held in annular groove **11** by suction air **17**, but can move freely in the circumferential direction.

[0069] Fig. lb shows a situation in which an air control body **18** is arranged in gap **15** and switches off the suction air **17**. This is, e.g., the situation shortly before a transfer to a take-over device. The controlling body **18** is arranged fixed in the separating apparatus.

[0070] FIGS. **2***a* and **2***b* show an accelerator wheel **10'** of another exemplary embodiment of the invention. Accelerator wheel **10'** has a wheel body **14**, which has a hole **16** arranged on one side that bends towards the outside periphery in the middle of wheel body **14**. In this manner, lateral hole **16** connects with the annular groove **11**. Further, suction air **17** is supplied at the lateral opening **16**.

[0071] FIG. **2***b* shows a lateral schematic representation of accelerator wheel **10'** depicted in FIG. **2***a*. The direction of rotation is indicated by arrow **19**. On the outer perimeter, annular groove **11** is indicated schematically in such a manner that the upper portion of perimeter defining annular groove **11** is not shown in order to view the objects **9** within annular groove **11**. Thus, an object chain with objects **9** is shown in annular groove **11**, and these objects enter annular groove **11** from an object supply volume (not shown). Holes **16**, which discharge into a gap which distributes suction air **17** evenly in annular groove **11**, are represented laterally in wheel body **14**. It is clear from FIG. **2***b* that objects **9** in the annular groove **11** line up into a more or less closed object chain **9***a*, which is accelerated jointly. In particular, at the end of the acceleration section in the annular groove **11**, objects **9** have mainly the shape of a closed object chain **9***a*.

[0072] FIG. **3** shows an exemplary embodiment of a separating and inserting apparatus **20** according to the invention schematically from the side. This separating and inserting apparatus **20** has a separation device **21** and a take-over device **30**. Separation device **21** has an object supply volume **22** with the width of an object layer, thus referred to as a "single-layer" apparatus. In this manner, the objects are arranged in a single layer because the width of the object supply volume **22** is restricted to its diameter.

[0073] Object supply volume **22** is in contact with a section of a perimeter of accelerator wheel **10** having a circumferential annular groove **11**, and the section changes as accelerator wheel **10** rotates in direction **19** so as to receive objects out of the object supply volume **22** and to accelerate them in rotational direction **19**. Object supply volume **22** is restricted by housing **25** the separating device **21**. A stripping wedge **24** is located downstream in direction of rotation **19** of accelerator wheel **10**, i.e., a wedge-shaped section of the housing **25** that serves to gently change the movement direction of objects, which are accelerated along by the accelerator wheel **10**, but do not make it into annular groove **11**. For this, the objects are stripped by an upper edge of stripping wedge **24** from accelerator wheel **10** and deflected at the bent side surface of a recess **23** so that they are in turn returned in the direction of object supply volume **22**. Thus, a large portion of the objects

remains in the object supply volume **22**. Moreover, further objects may be refilled into object supply volume **22** through an upper inlet **26**.

[0074] Downstream in direction of rotation **19** of accelerator wheel **10**, housing **25** seals annular groove **11** of the accelerator wheel **10** towards the outside. The object chain in annular groove **11** is thus further conveyed with accelerator wheel **10** through a transfer section **36***a* to a receiving section **36**. In transfer section **36***a*, the objects continue to be located in annular groove **11**. Another stripping wedge (not shown in detail), which ensures that the objects of the object chain are received in receiving section **36** from annular groove **11**, is located at the transfer point from transfer section **36***a* to receiving section **36** of the take-over device.

[0075] Receiving section **36** is part of take-over device **30**, which is shown in FIG. **3** as an insertion belt **31**. Insertion belt **31**, which has one or more rows of object receptacles **32**, is moved in a conveying direction **31***a* and thus moves parallel to the objects of the object chain in receiving section **36**, however, if applicable, with a certain differential speed, which can also change through friction in the progression of the parallel conveyance in receiving section **36**.

[0076] Along receiving section **36**, a vacuum pressure zone or respectively a vacuum pressure area **35** is arranged on an inside of insertion belt **31**, in which suction air is applied on or to the object receptacles **32** from the inside to hold the objects that make their way into the object receptacles **32**. Vacuum pressure area **35** extends over an entire length of the receiving section **36** and up to insertion zone **38**, at which the objects from object receptacles **32** are inserted into a material rod **1**. The further-conveyed material rod with the inserted objects then has the reference number **2**. The conveying direction of the material rod **1**, **2** is indicated with arrows.

[0077] Insertion belt **31** is conveyed via an upper return pulley **33** and a lower return pulley **34**, to rotate in the direction **31***a*. Lower return pulley **34** is simultaneously designed for inserting the objects from the object receptacles **32** of the insertion belt **31** into the material rod **1**. This process is described in greater detail in the Applicant's above-mentioned German Patent Application number DE 10 2011 017 615.2, which has been expressly incorporated by reference herein in its entirety.

[0078] Through the formation of an object chain in annular groove **11** and the transfer of accelerated object chain into receiving section **36** of insertion belt **31**, an excess of objects is conveyed over a longer receiving section **36** on insertion belt **31**, so that there is a high probability that all object receptacles **32** of insertion belt **31** are filled with objects. Since the differential speed is small compared to the state of the art, the receipt of the objects in object receptacles **32** is performed in a gentle manner. The excess objects are discharged and received at the end of receiving section **37** and, if applicable, returned to object supply volume **22**.

[0079] FIG. **4** shows a second exemplary embodiment of a separating and inserting apparatus **40** according to the invention. The upper part, i.e., separation device **41**, is designed similarly to those from FIG. **3**, in that separation device **41** has an object supply volume **42** with an upper inlet **46**, a stripping wedge **44** and a recess **43**. Object supply volume **42** is connected with a part of the perimeter of an accelerator wheel **10** with an annular groove **11** rotating in direction **19**. Recess **43** has in this case an island-shaped blocked area **43***a*, which defines a bent channel **43***b*, whereby an object flow made up of excess objects is returned to the object supply volume **42** in a very orderly manner.

[0080] A part of the housing **45** forms an air control body **18** that switches off the suction air on annular groove **11** over a certain section of the perimeter of accelerator wheel **10**.

[0081] Transfer section **56***a* extends approximately from stripping wedge **44** to a downstream take-over device **50** that is designed as an insertion wheel **51**. The length of transfer section **56***a* depends on geometric ratios in the apparatus and is designed in this exemplary embodiment over an area of approx. 170° of the perimeter of accelerator wheel **10**.

[0082] Stripping wedge **55** is arranged to ensure that, rather than remaining in annular groove **11**, the objects of the object chain in annular groove **11** are deflected into receiving section **56** designed as a channel located along a portion of the perimeter of insertion wheel **51** at a transition from transfer section **56***a* to receiving section **56**. In receiving section **56**, the objects of the object chain are conveyed with a differential speed around or past insertion wheel **51**, which has discrete object receptacles **52** on its perimeter and suction air applicable to each object receptacle **52**. Through this parallel conveyance with object excess and, if applicable, a differential speed, the probability that individual receptacles **52** remain unoccupied is minimized.

[0083] At the end of receiving section **56**, a stripping wedge **55'** strips off the non-received objects and deflects them into a discharge channel **57**, out of which they exit and are discharged, caught and returned, if applicable, to object supply volume **42**.

[0084] FIG. **5** shows schematically a third embodiment of a separating and inserting apparatus **60** according to the invention, which receives a separation device **61** according to the invention with an accelerator wheel **10** in the upper and left part, wherein in a housing **65** in turn an object supply volume **62** with a stripping wedge **64**, a recess **63** with island-like blocked area **63***a* and bent channel **63***b* is arranged, wherein objects in the annular groove **11** of the accelerator wheel are accelerated and transferred via a transfer section **76***a* to a receiving section **76** on a take-over device, which is designed as an insertion wheel **71**.

[0085] The insertion wheel **71** with the discrete object receptacles **72** rotates in the direction of the arrow. Like in the exemplary embodiment in FIG. **4**, also in the example in according to FIG. **5**, an object chain is transferred from annular groove **11** of accelerator wheel **10** into receiving section **76** designed as a channel and conveyed past object receptacles **72** of insertion wheel **71** such that objects received in object receptacles **72** are inserted into a material rod **1** in an insertion zone **78**.

[0086] In contrast to the exemplary embodiment in accordance with Fig, **4**, a stripping wedge **75** is connected to the receiving section **76** on the insertion wheel **71** in FIG. **5**, which diverts the excess objects to a second accelerator wheel **10"**. These objects are received in annular groove **11** of second accelerator wheel **10"** and are in turn accelerated in the direction of the arrow. Housing **65** thereby forms a return section **77** around second accelerator wheel **10"**, or respectively return section **77** is designed as a section of annular groove **11** of second accelerator wheel **10"**. The objects in turn accelerated are received by a second stripping wedge **75'** out of annular groove **11** of second accelerator wheel **10"** and conveyed back to the object supply volume **62** through a return channel **79**, where they can re-penetrate into annular

groove **11** of first accelerator wheel **10**. Return channel **79** is thereby protected from objects falling out of the upper inlet of object supply volume **62** by a protruding part of the housing wall so that an object jam does not form there. Instead, the objects coming from above on the bent wall with reference number **65**'are diverted directly in the direction of first accelerator wheel **10**.

[0087] FIG. **6** shows schematically an accelerator wheel **10**, the circumferential annular groove **11** of which leads into channels **15***a* progressing radially inward. These ensure that the suction air supplied to annular groove **11** makes its way evenly and without turbulence from outside through annular groove **11** towards the inside into accelerator wheel **10**, independently of where the objects in annular groove **11** are located. This once again improves the pickup behavior for the objects. Channels **15***a,* which are arranged radially in FIG. **6**, can be arranged to be tilted with respect to or oriented at an angle to the radial.

[0088] All named characteristics, including those taken from the drawings alone, and individual characteristics, which are disclosed in combination with other characteristics, are considered alone and in combination as important to the invention. Embodiments according to the invention can be fulfilled through individual characteristics or a combination of several characteristics.

[0089] Further, it is noted that the foregoing examples have been provided merely for the purpose of explanation and are in no way to be construed as limiting of the present invention. While the present invention has been described with reference to an exemplary embodiment, it is understood that the words which have been used herein are words of description and illustration, rather than words of limitation. Changes may be made, within the purview of the appended claims, as presently stated and as amended, without departing from the scope and spirit of the present invention in its aspects. Although the present invention has been described herein with reference to particular means, materials and embodiments, the present invention is not intended to be limited to the particulars disclosed herein; rather, the present invention extends to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims.

LIST OF REFERENCES

[0090] **1** Material rod
[0091] **2** Material rod with objects
[0092] **9** Object
[0093] **9***a* Object chain
[0094] **10-10"** Accelerator wheel
[0095] **11** Annular groove
[0096] **12**, **13** Disk
[0097] **14** Wheel body
[0098] **15** Gap
[0099] **15***a* Radial channel
[0100] **16** Hole
[0101] **17** Suction air
[0102] **18** Controlling body
[0103] **19** Direction of rotation
[0104] **20** Separating and inserting apparatus
[0105] **21** Separation device
[0106] **22** Object supply volume
[0107] **23** Recess
[0108] **24** Stripping wedge
[0109] **25** Housing
[0110] **26** Upper inlet
[0111] **30** Take-over device
[0112] **31** Insertion belt
[0113] **31***a* Conveying direction of the insertion belt
[0114] **32** Object receptacles
[0115] **33**, **34** Return pulley
[0116] **35** Low pressure area
[0117] **36** Receiving section
[0118] **36***a* Transfer section
[0119] **37** End of the receiving section
[0120] **38** Insertion zone
[0121] **40** Separating and inserting apparatus
[0122] **41** Separation device
[0123] **42** Object supply volume
[0124] **43** Recess
[0125] **43***a* Island-like blocked area
[0126] **43***b* Bent channel
[0127] **44** Stripping wedge
[0128] **45** Housing
[0129] **46** Upper inlet
[0130] **50** Take-over device
[0131] **51** Insertion wheel
[0132] **52** Object receptacles
[0133] **55**, **55'** Stripping wedge
[0134] **56** Receiving section
[0135] **56***a* Transfer section
[0136] **57** Discharge channel
[0137] **58** Insertion zone
[0138] **60** Separating and inserting apparatus
[0139] **61** Separation device
[0140] **62** Object supply volume
[0141] **63** Recess
[0142] **63***a* Island-like blocked area
[0143] **63***b* Bent channel
[0144] **64** Stripping wedge
[0145] **65** Housing
[0146] **66** Upper inlet
[0147] **70** Take-over device
[0148] **71** Insertion wheel
[0149] **72** Object receptacles
[0150] **75**, **75'** Stripping wedge
[0151] **76** Receiving section
[0152] **76***a* Transfer section
[0153] **77** Return section
[0154] **78** Insertion zone
[0155] **79** Return channel

What is claimed:

1. A method for separating and inserting objects into at least one material rod of the tobacco-processing industry, comprising:

receiving objects from an object supply volume into an annular groove on an outer perimeter of an accelerator wheel rotating around an axis of rotation;

supplying the annular groove with suction air, whereby the objects are held in the annular groove;

accelerating the objects in a course of the rotation of the accelerator wheel;

conveying the objects to a take-over device having discrete object receptacles for the objects;

receiving at least some of the objects in a receiving section along a conveying path of the objects in the object receptacles of the take-over device;

conveying, downstream of the receiving station, the objects in the object receptacles; and

inserting the objects into the material rod through one of the take-over device or an insertion device arranged downstream in the conveying direction of the objects,

wherein excess objects, which were not received in the receiving section in an object receptacle, are at least one of discharged after leaving the receiving section and returned to the object supply volume.

2. The method according to claim **1**, wherein the at least one material rod of the tobacco-processing industry is an endless filter rod.

3. The method according to claim **1**, wherein the objects on the accelerator wheel are accelerated to a speed that exceeds a conveying speed of the take-over device.

4. The method according to claim **1**, wherein an excess of objects in relation to the receptacles is conveyed to the take-over device.

5. The method according to claim **4**, wherein at least some of the excess objects are returned to the object supply volume via a second accelerator wheel coupled to the take-over device, the second accelerator wheel having an annular groove supplied with suction air.

6. The method according to claim **1**, further comprising switching off the suction air along a portion of the perimeter of the accelerator wheel.

7. The method according to claim **6**, wherein the portion of the perimeter along which the suction air is switched off is arranged, in a direction of rotation, between a transfer point to the take-over device and a point where the annular groove penetrates into the object supply volume.

8. An apparatus for separating and inserting objects into at least one material rod of the tobacco-processing industry comprising:

an object supply volume;

a take-over device comprising discrete object receptacles structured to receive the objects;

a receiving section arranged on the take-over device and along a conveying path of the objects received in the object receptacles;

at least one of the take-over device being structured and arrange to insert objects into the material rod or an insertion device is structured to insert objects into the material rod and arranged one of directly and indirectly in the conveying direction of the objects downstream from the take-over device;

a rotating or rotatable accelerator wheel being structured and arranged between the object supply volume and the take-over device, the accelerator wheel having an annular groove on a perimeter to which suction air is applied or applicable,

wherein a width of the annular groove corresponds to a diameter of the objects.

9. The apparatus according to claim **8**, wherein the at least one material rod of the tobacco-processing industry is an endless filter rod and the width of the annular groove is one of not greater than or only slightly greater than the diameter of the objects.

10. The apparatus according to claim **8**, wherein a depth of the annular groove matches the diameter of the objects.

11. The apparatus according to claim **8**, wherein a width of the object supply volume corresponds with the diameter of the objects.

12. The apparatus according to claim **11**, the object supply volume being defined in part by side walls arranged flush with side walls of the annular groove.

13. The apparatus according to claim **8**, wherein the take-over device comprises one of a take-over belt, an insertion belt, a take-over wheel or an insertion wheel.

14. The apparatus according to claim **8**, further comprising a second accelerator wheel is arranged downstream of the take-over device in the conveying direction of the objects, the second accelerator being structured and arranged to return excess objects to the object supply volume.

15. The apparatus according to claim **14**, wherein the accelerator wheel and the second accelerator wheel each comprise two disks arranged to form at least one of a gap, radially aligned channels or radially tilted channels for suction air, and the disks on their perimeters have a lateral portion of the annular groove, and the apparatus further comprises a fixed air control body engaging in the gap between the disks being structured and arranged for at least one of switching off the suction air and taking the objects out of the annular groove.

16. The apparatus according to claim **8**, wherein the accelerator wheel comprises two disks arranged to form at least one of a gap, radially aligned channels or radially tilted channels for suction air, and the disks on their perimeters have a lateral portion of the annular groove, and the apparatus further comprises a fixed air control body engaging in the gap between the disks being structured and arranged for at least one of switching off the suction air and taking the objects out of the annular groove.

17. The apparatus according to claim **8**, wherein the accelerator wheel has openings on one or both side surfaces, which are flush with a corresponding, fixed, annular-section-shaped suction air nozzle and are connected with the annular groove inside the accelerator wheel.

18. The apparatus according to claim **8**, wherein the accelerator wheel is arranged to extend into the object supply volume, and in a region of an exit of the accelerator wheel out of the object supply volume, a side wall of the object supply volume forms wedge-shaped sections for stripping off objects taken along outside of the annular groove,

wherein the side wall on the side of the wedge-shaped section facing away from the accelerator wheel has a recess, by which the stripped objects are steered or are steerable back into the object supply volume, and

wherein the recess in its center has an island-like blocked area so that a bent channel for the objects is formed in the recess around the blocked area.

19. The apparatus according to claim **8**, wherein the accelerator wheel is arranged between the object supply volume and a transfer position to the take-over device in a housing that is arranged so tightly on the perimeter of the accelerator wheel that objects cannot leave the annular groove.

20. The apparatus according to claim **8**, wherein a speed of the accelerator wheel is regulatable.

21. A rod maker machine of the tobacco-processing industry comprising at least one apparatus according to claim **8** for making at least one endless filter rod.

22. A method of operating an accelerator wheel having a perimeter with an annular groove, the method comprising:

supplying suction air to discrete receptacles in the annular groove to receive objects from an object supply volume;

accelerating the objects from the object supply volume; and

conveying more objects than the objects in the receptacles to a take-over device.

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