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(54) **RELATING TO SMOKING ARTICLE ASSEMBLY**

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§ 371 (c)(1),
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PCT Pub. Date: **Jun. 12, 2014**

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(63) Continuation of application No. 17/890,303, filed on Aug. 18, 2022, which is an application for the reissue of Pat. No. 10,772,351.

(30) **Foreign Application Priority Data**

Dec. 6, 2012 (GB) 1222005

(51) **Int. Cl.**
A24C 5/47 (2006.01)
A24C 5/10 (2006.01)

(52) **U.S. Cl.**
CPC ***A24C 5/475*** (2013.01); ***A24C 5/10*** (2013.01); ***A24C 5/47*** (2013.01)

(58) **Field of Classification Search**
CPC A24C 5/00; A24C 5/10; A24C 5/47; A24C 5/475; A24D 3/00
See application file for complete search history.

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Primary Examiner — William E Dondero
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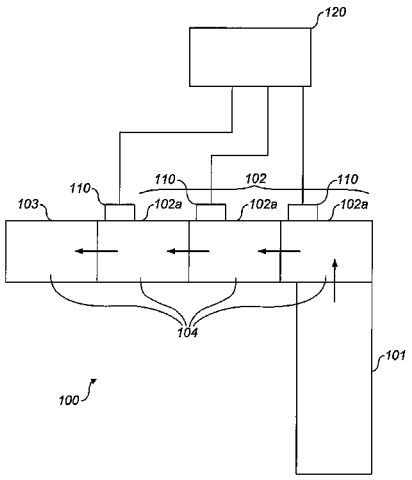
(57) **ABSTRACT**

A modular apparatus for smoking article assembly comprises a plurality of modules and a plurality of respective interface units, and a controller to control said plurality of
(Continued)



modules via said interface units. The modular apparatus is configured to cause received rods of smokable material to undergo a first sequence of operations. The modular apparatus can be reconfigured so as to cause received rods of smokable material to undergo a second sequence of operations, different to the first sequence of operations. The first and second sequences of operations respectively form at least part of first and second processes for assembling smoking articles, each smoking article comprising one of said rods of smokable material, which is smoked in use.

40 Claims, 18 Drawing Sheets

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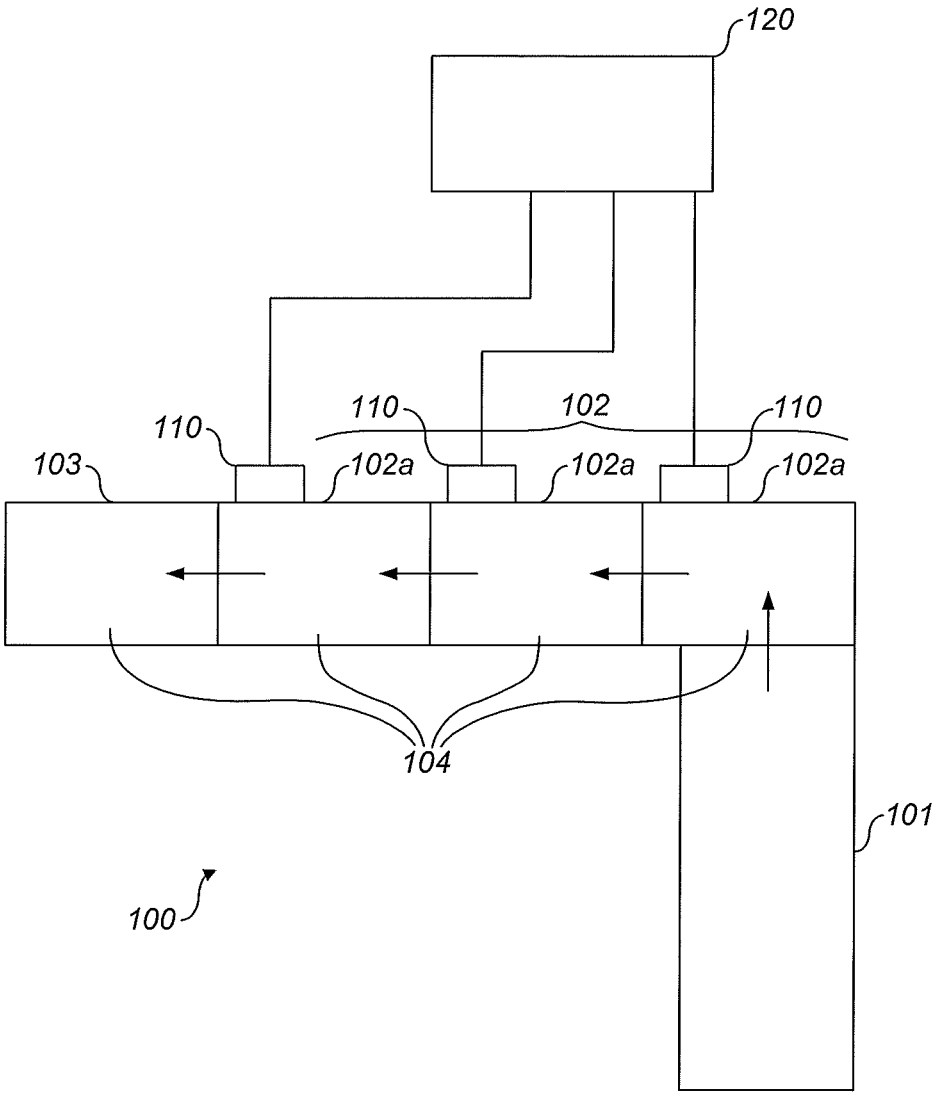

FIG. 1

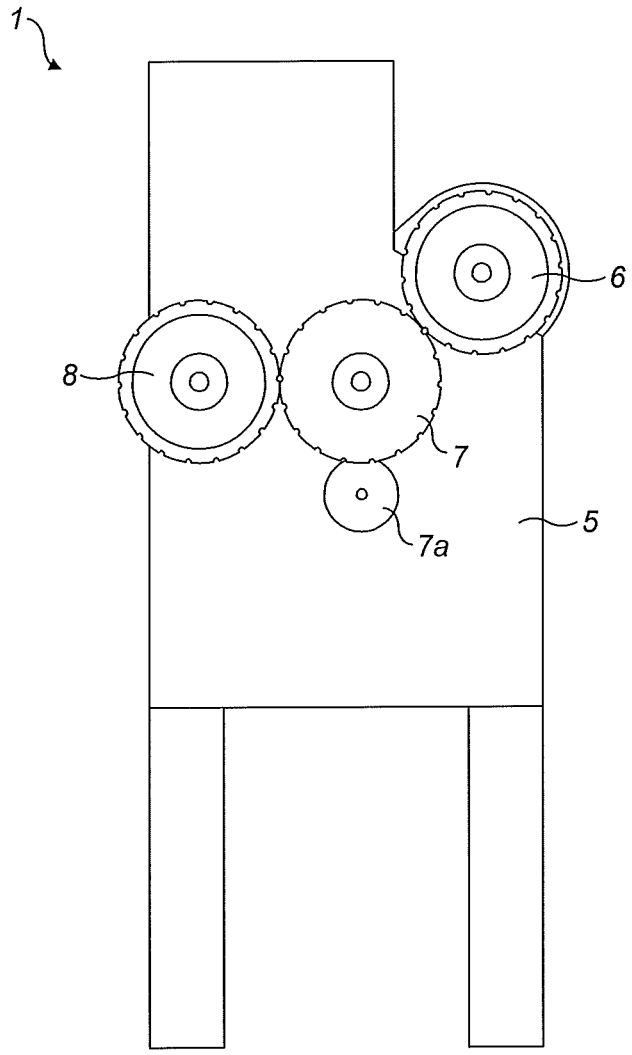

FIG. 1a

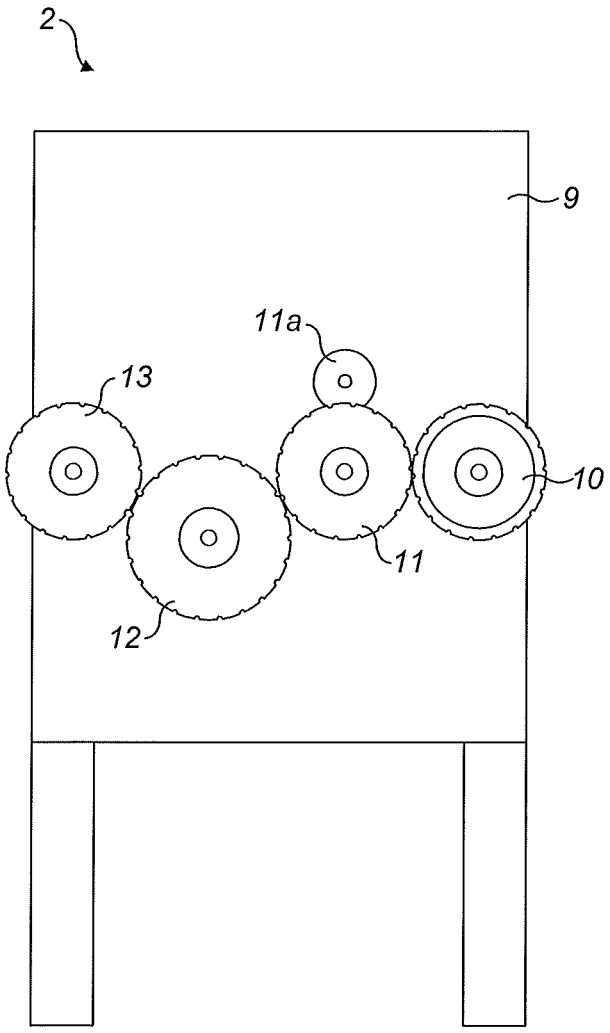

FIG. 2

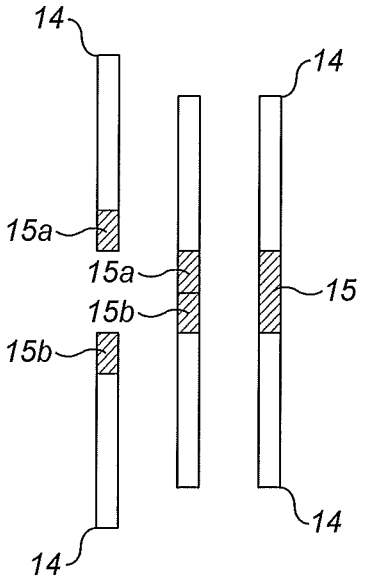

FIG. 2A

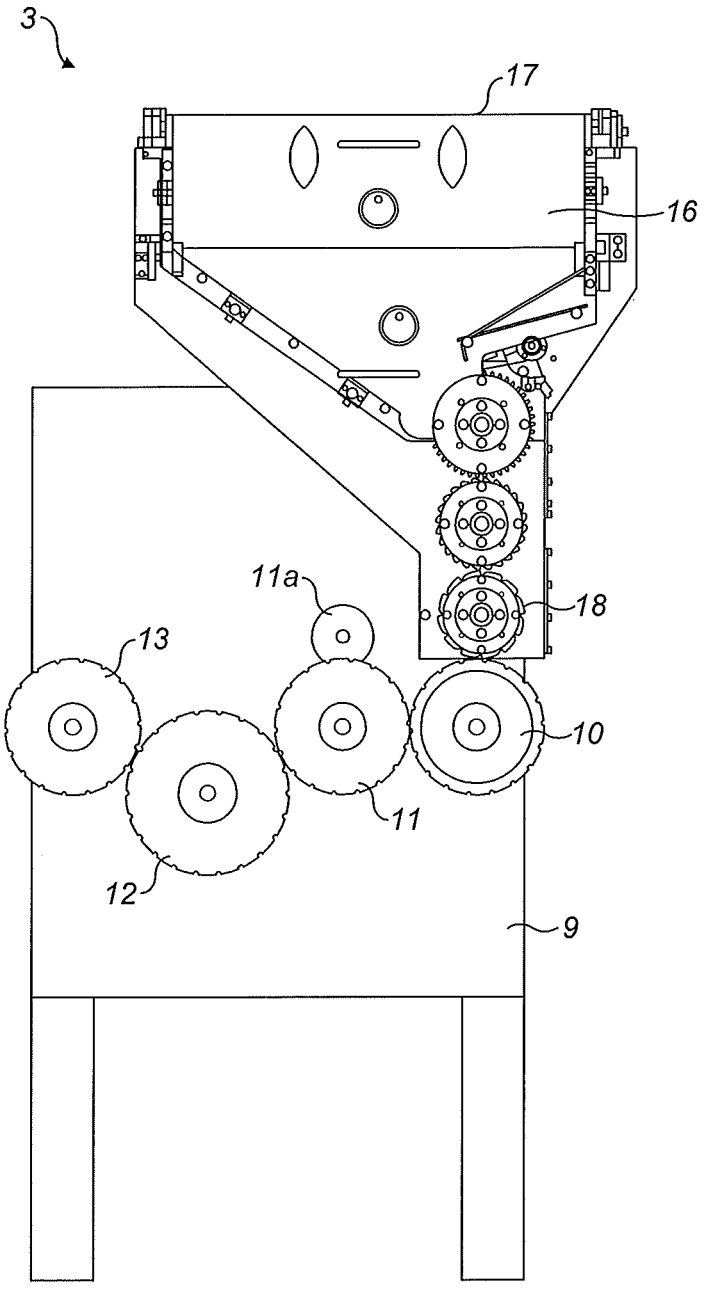

FIG. 3

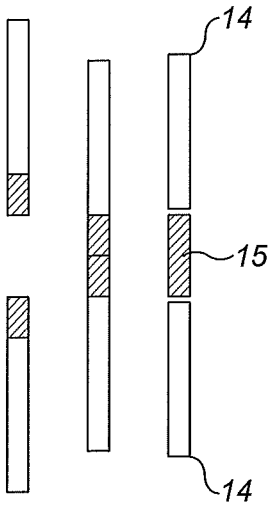

FIG. 3A

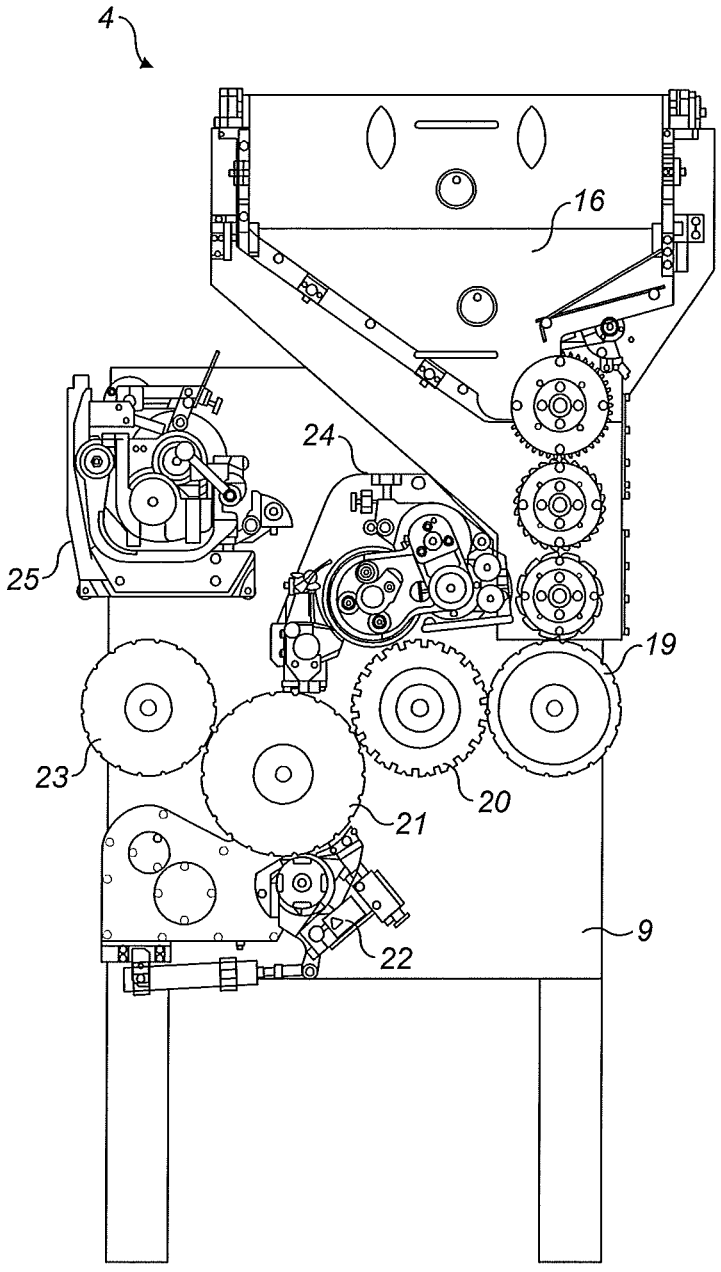

FIG. 4

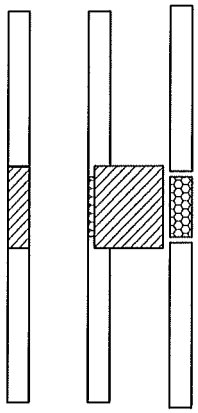

FIG. 4A

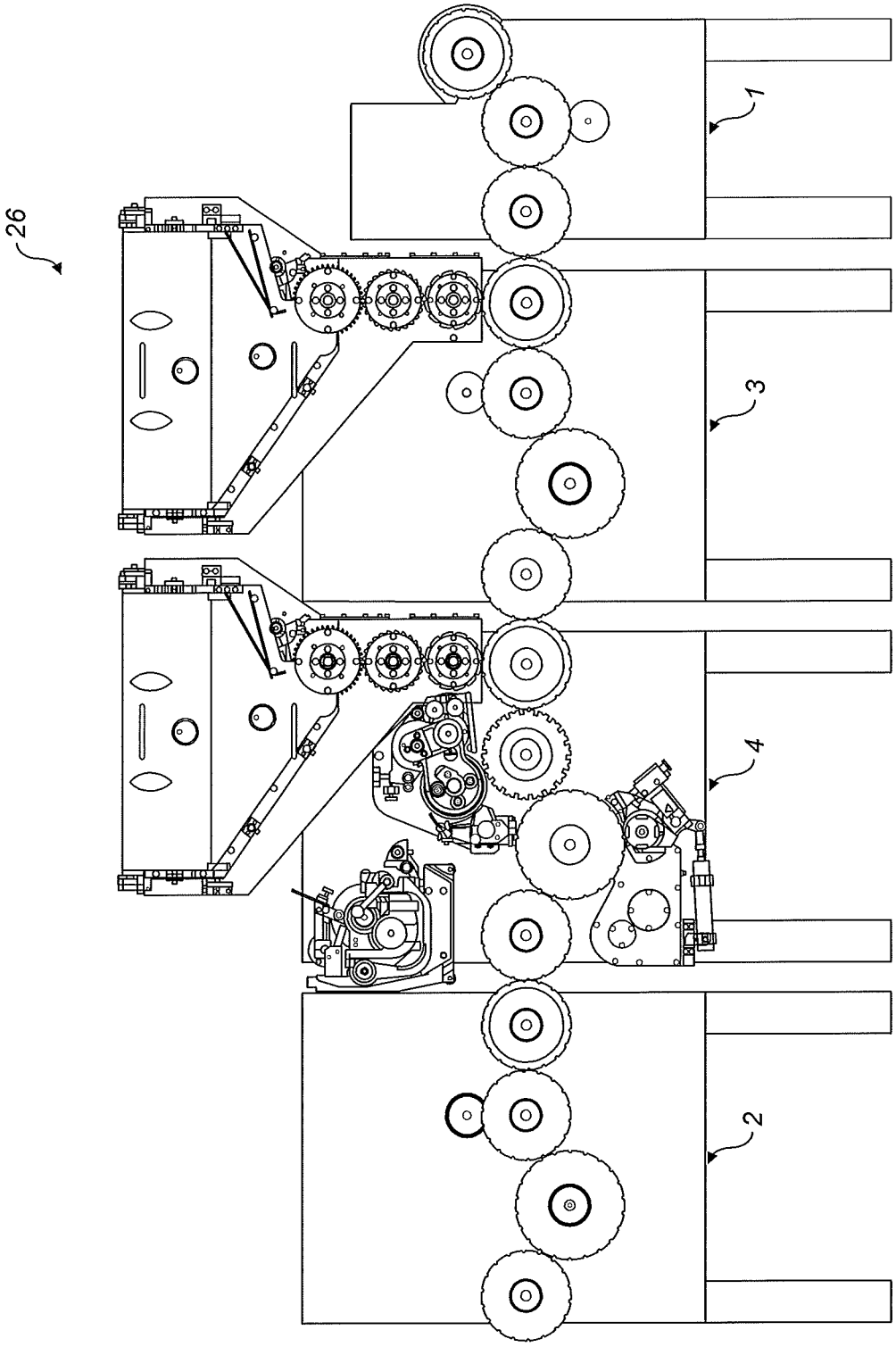

FIG. 5

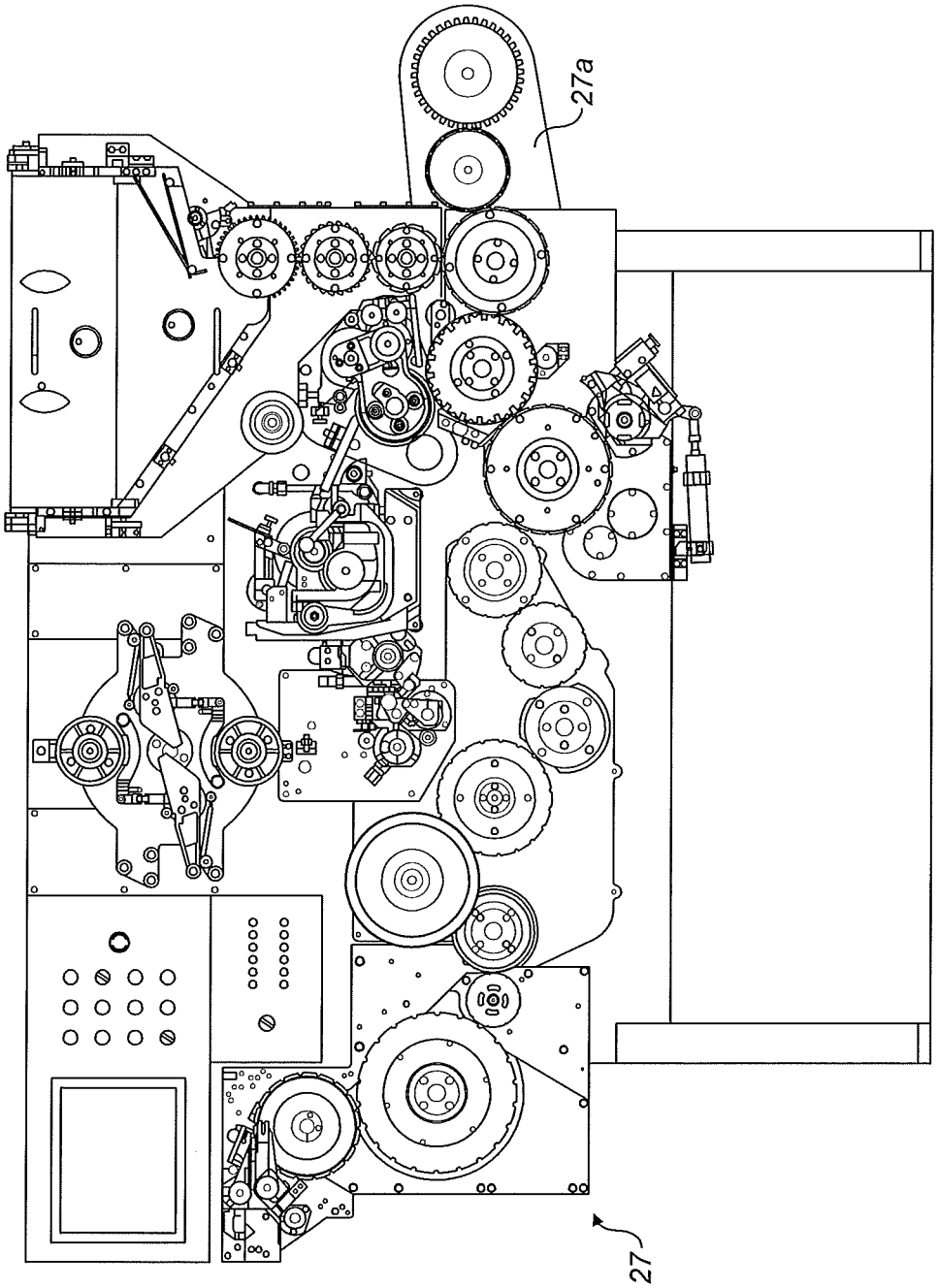

FIG. 6A

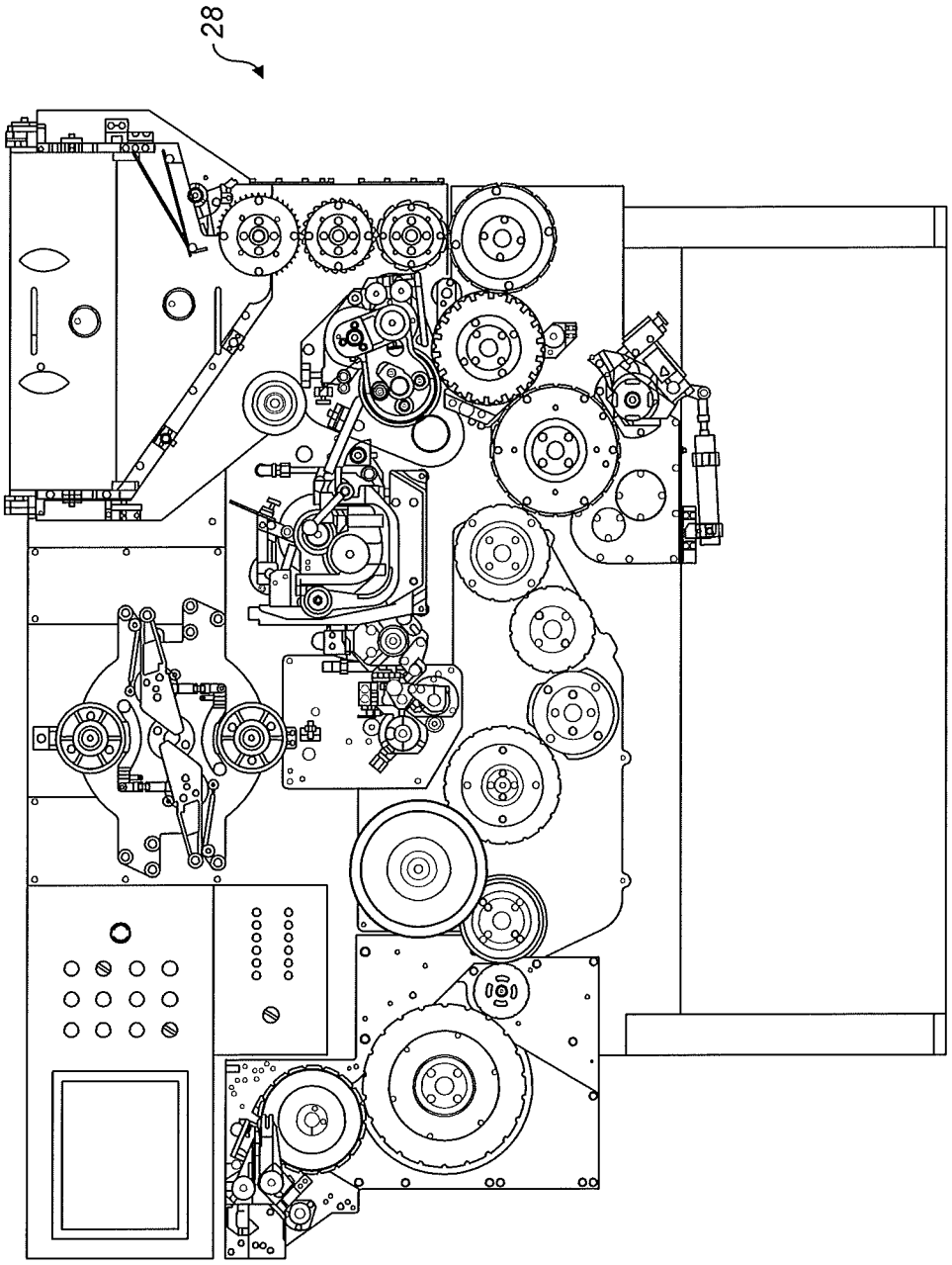

FIG. 6B

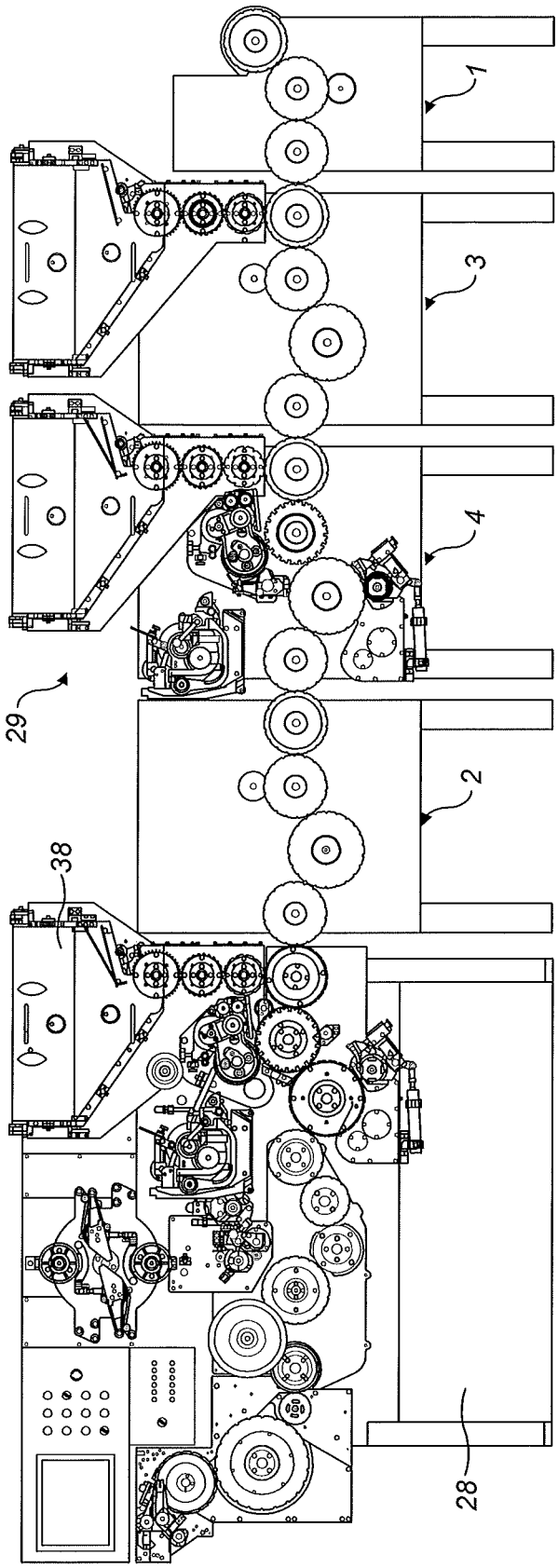

FIG. 7

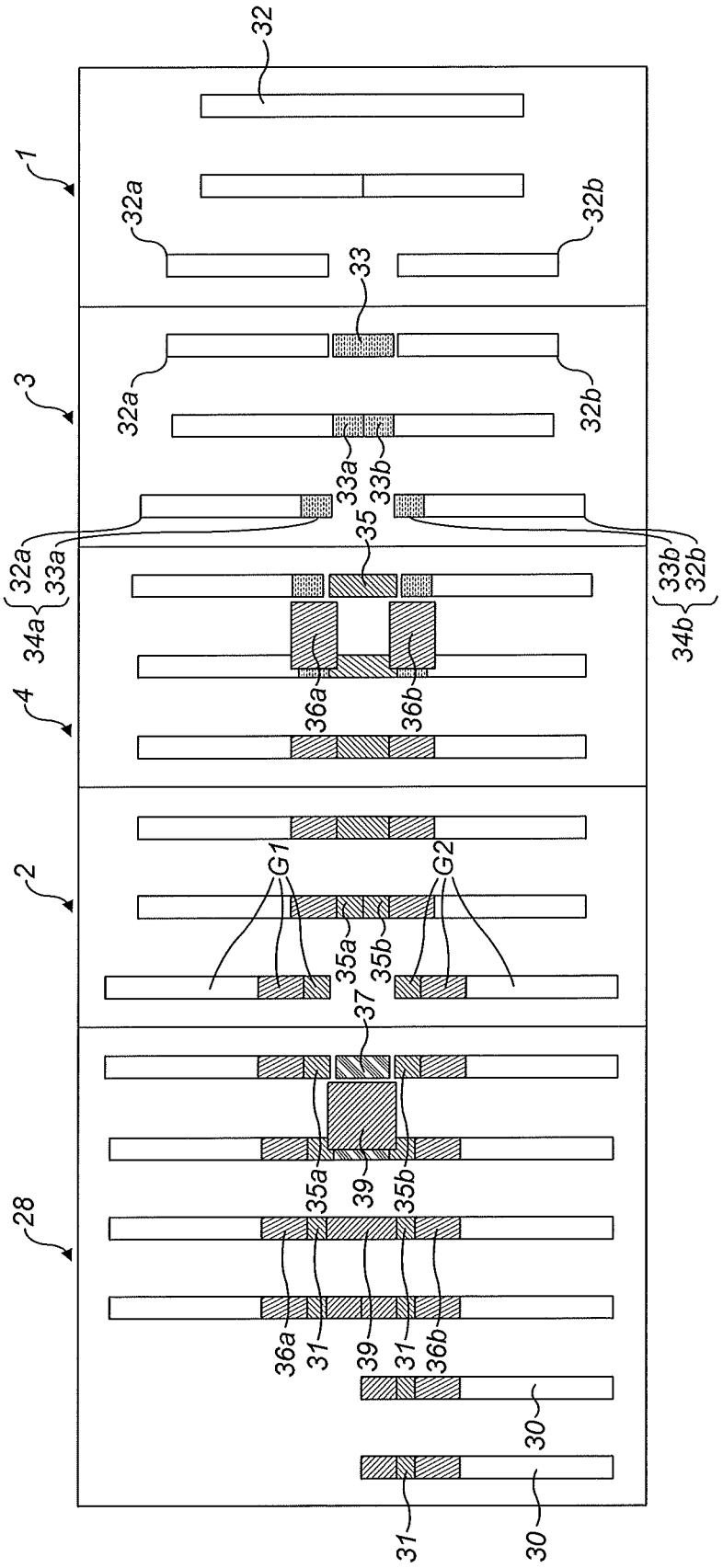
32
1
32a
32b
33
3
32a
32b
33a
33b
35
32a
33a
33b
32b
34a
34b
4
36a
36b
2
G1
G2
35a
35b
37
28
35a
39
35b
36a
31
39
31
36b
30
31
30

FIG. 7A

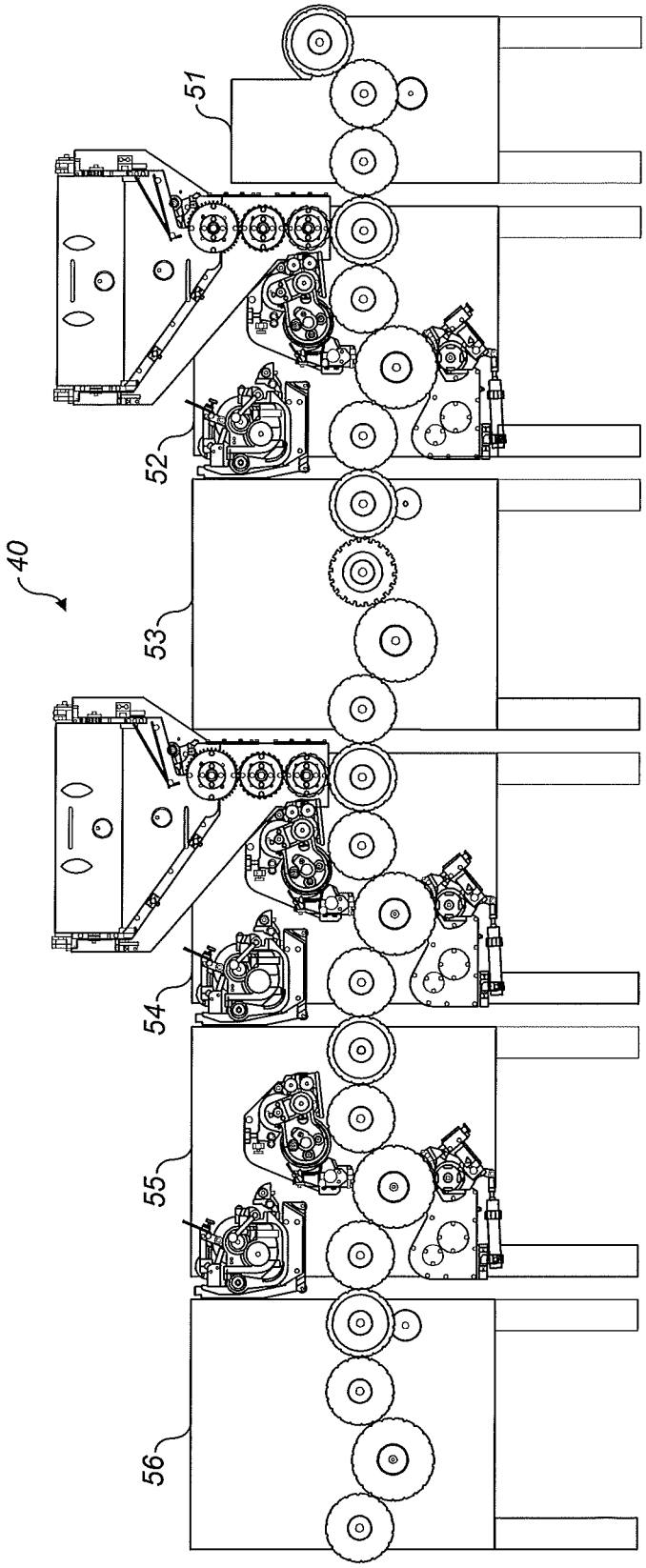

FIG. 8

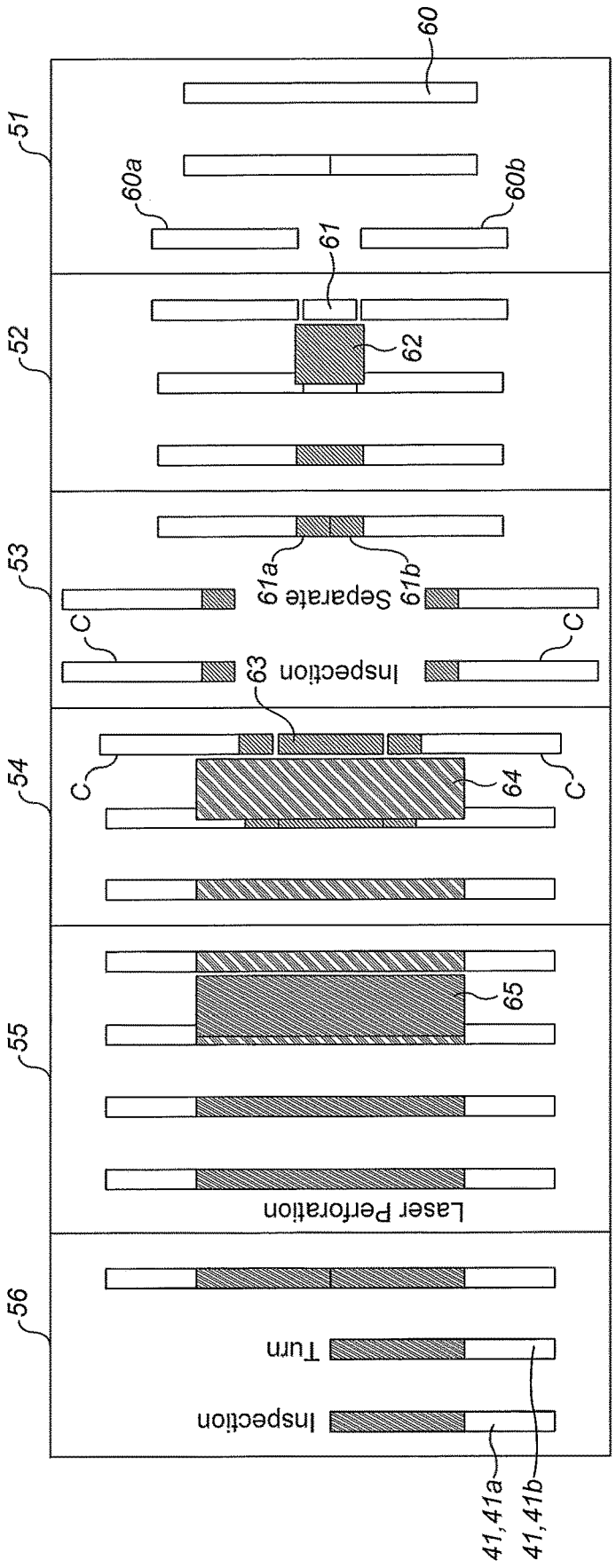
60
51
60a
60b
61
52
62
53
61a
61b
Separate
C
C
Inspection
63
54
C
64
C
55
65
Laser Perforation
56
Turn
Inspection
41, 41a
41, 41b

FIG. 8a

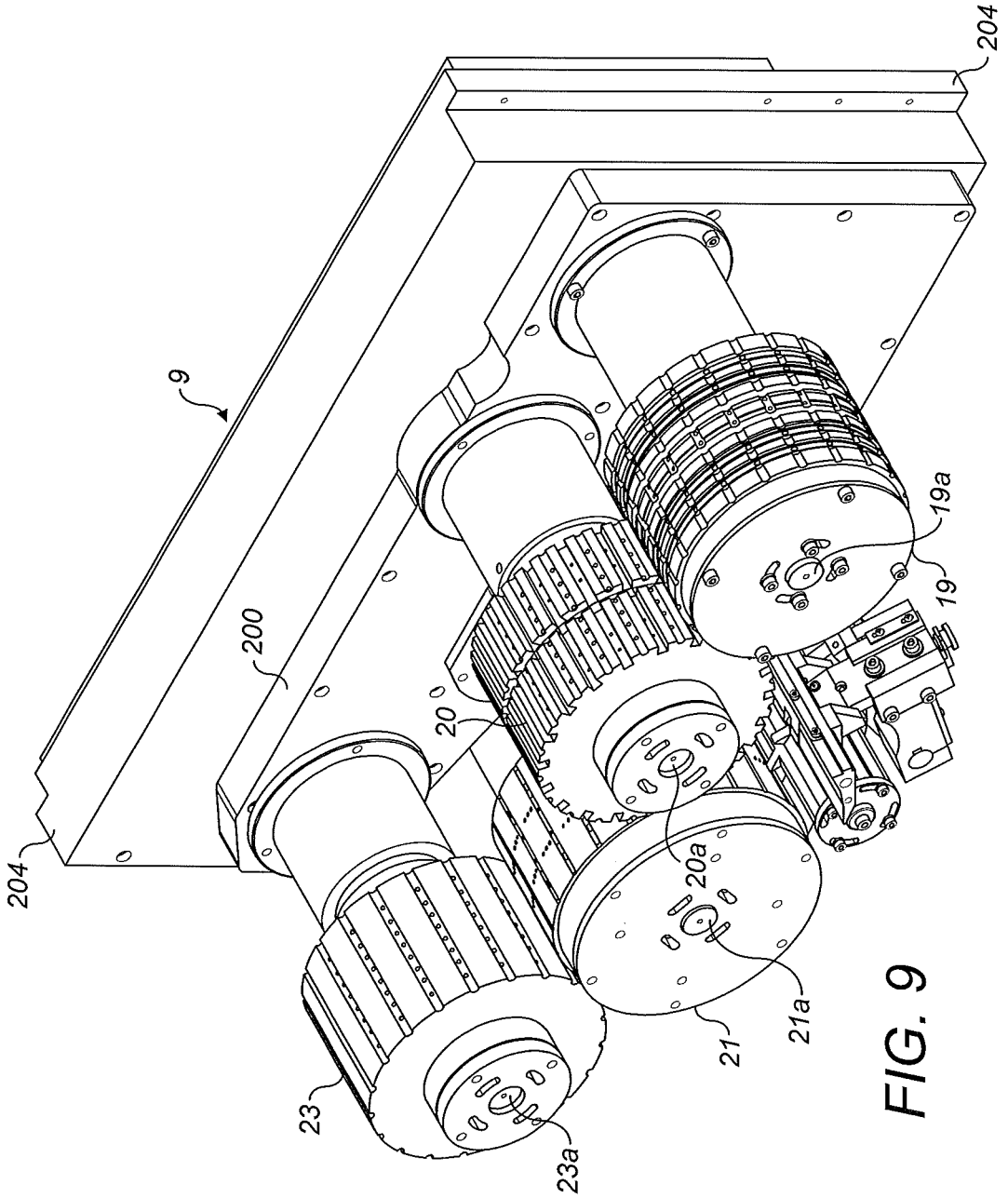

FIG. 9

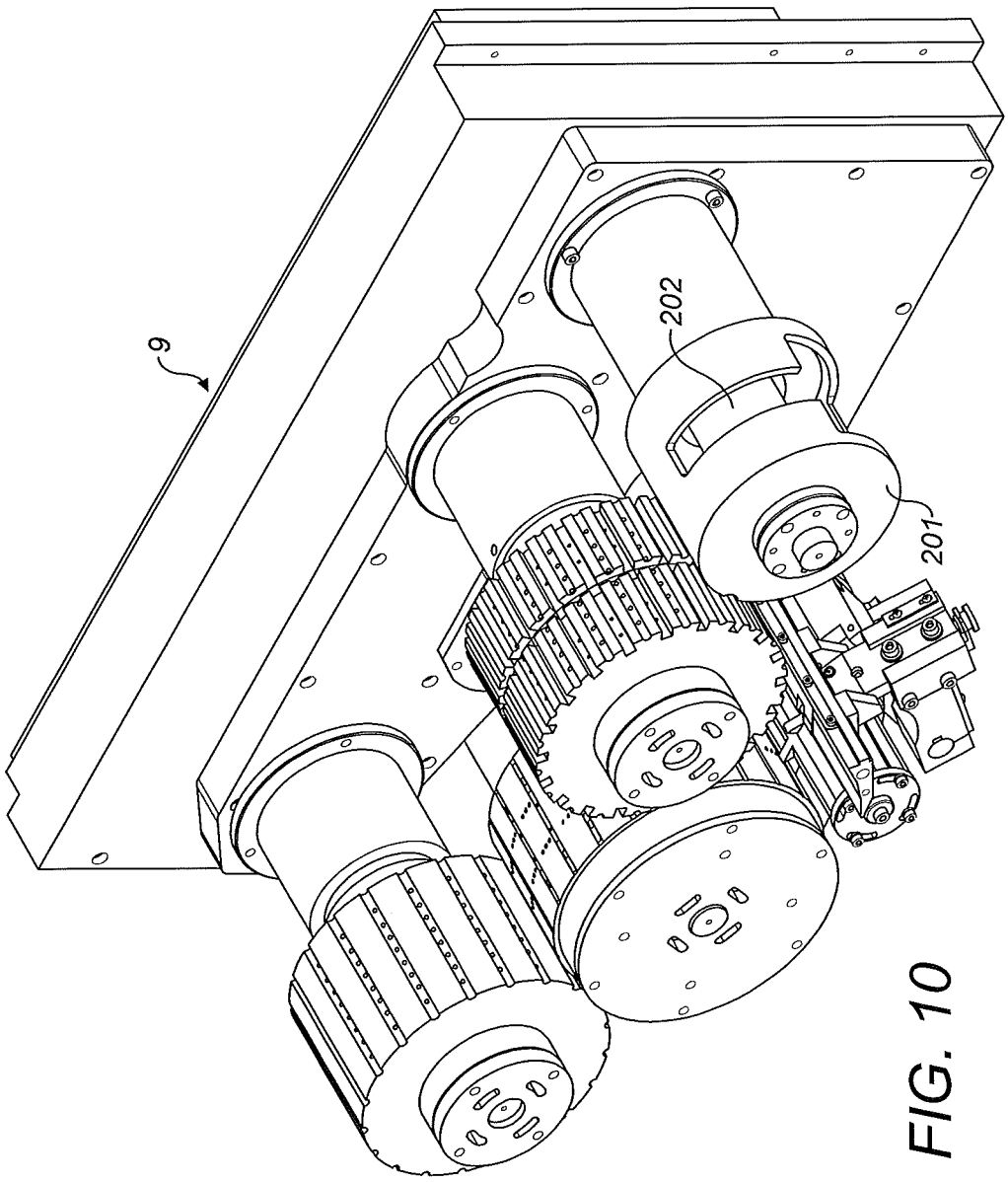

FIG. 10

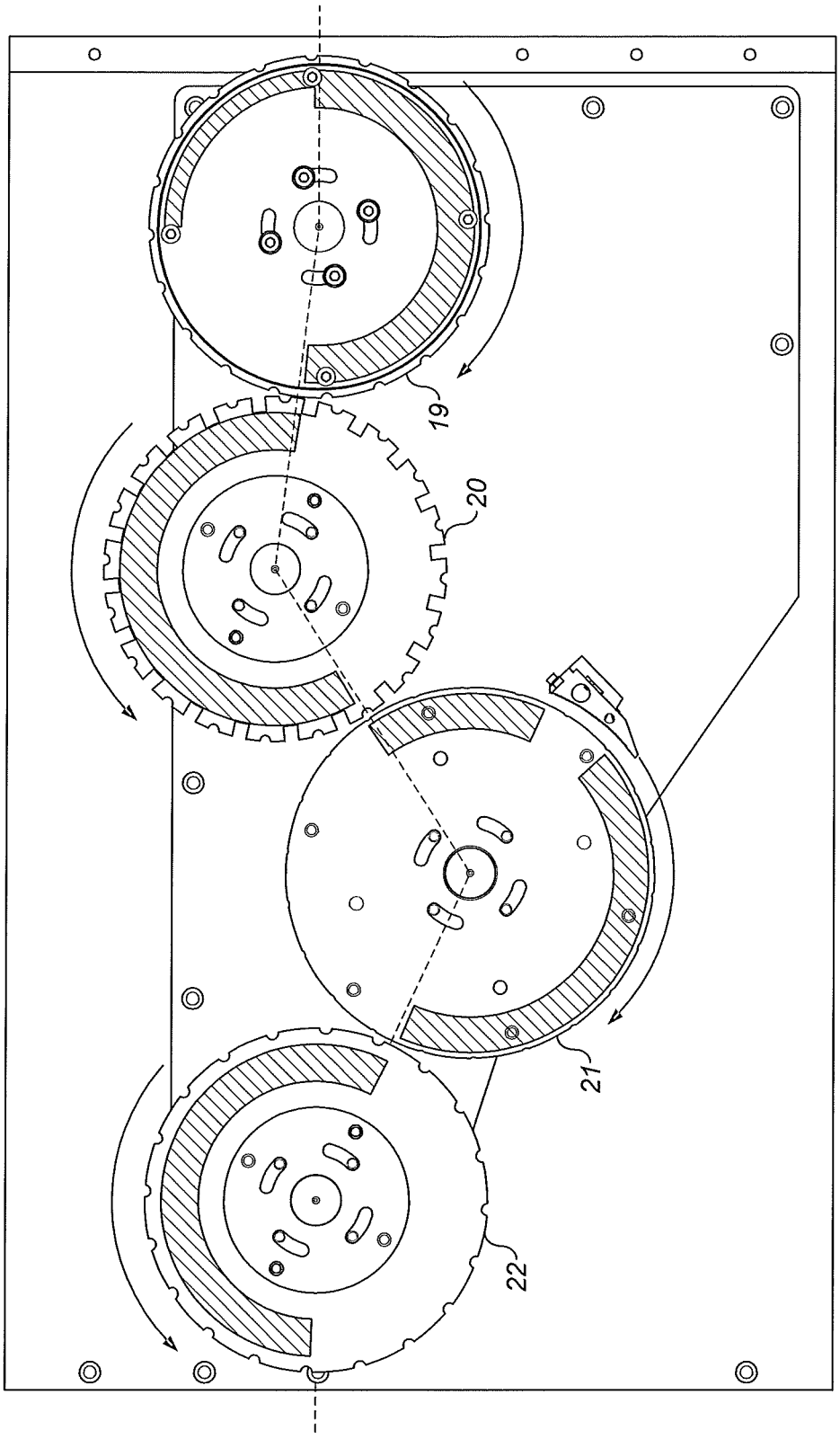

FIG. 11

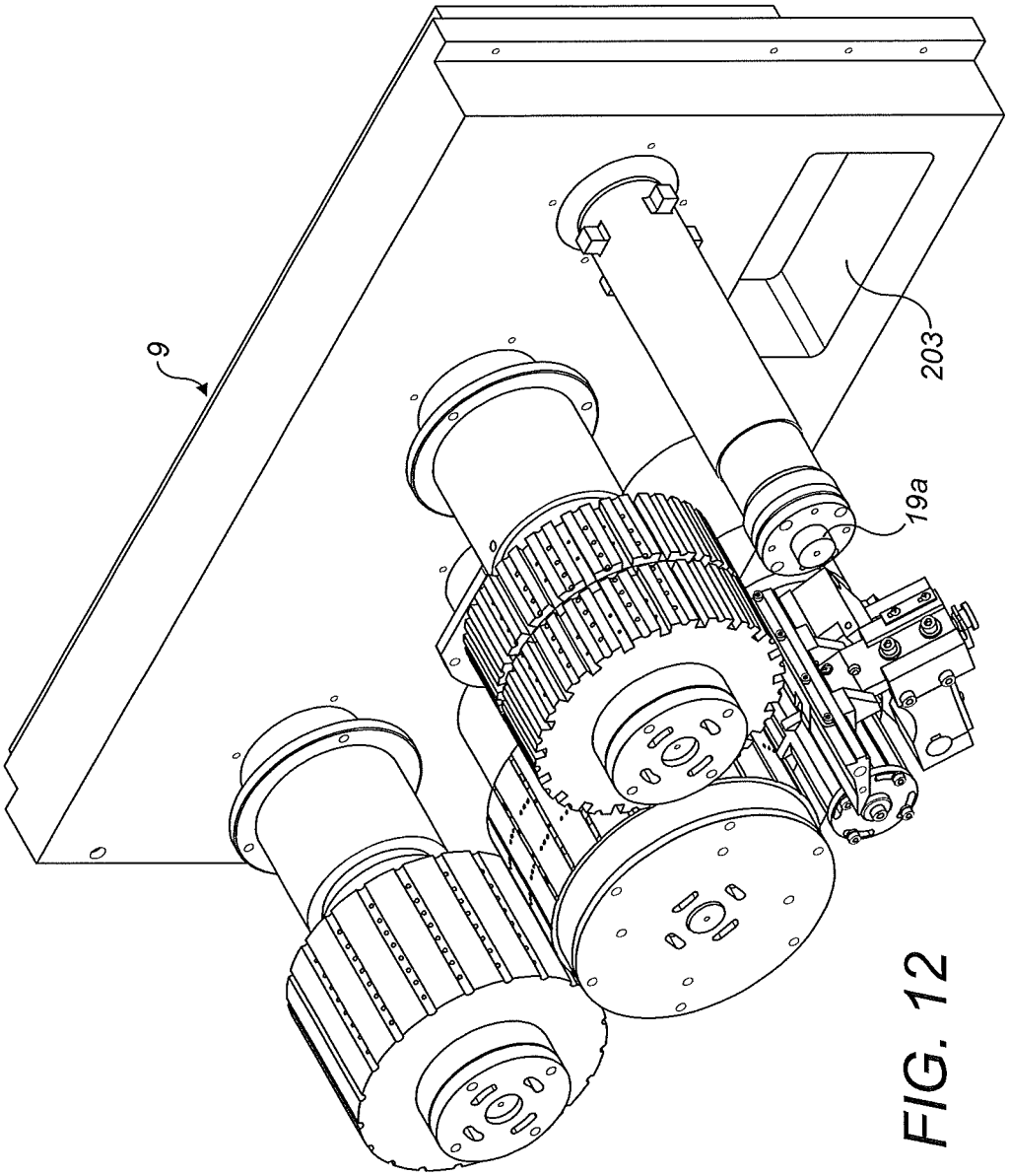

FIG. 12

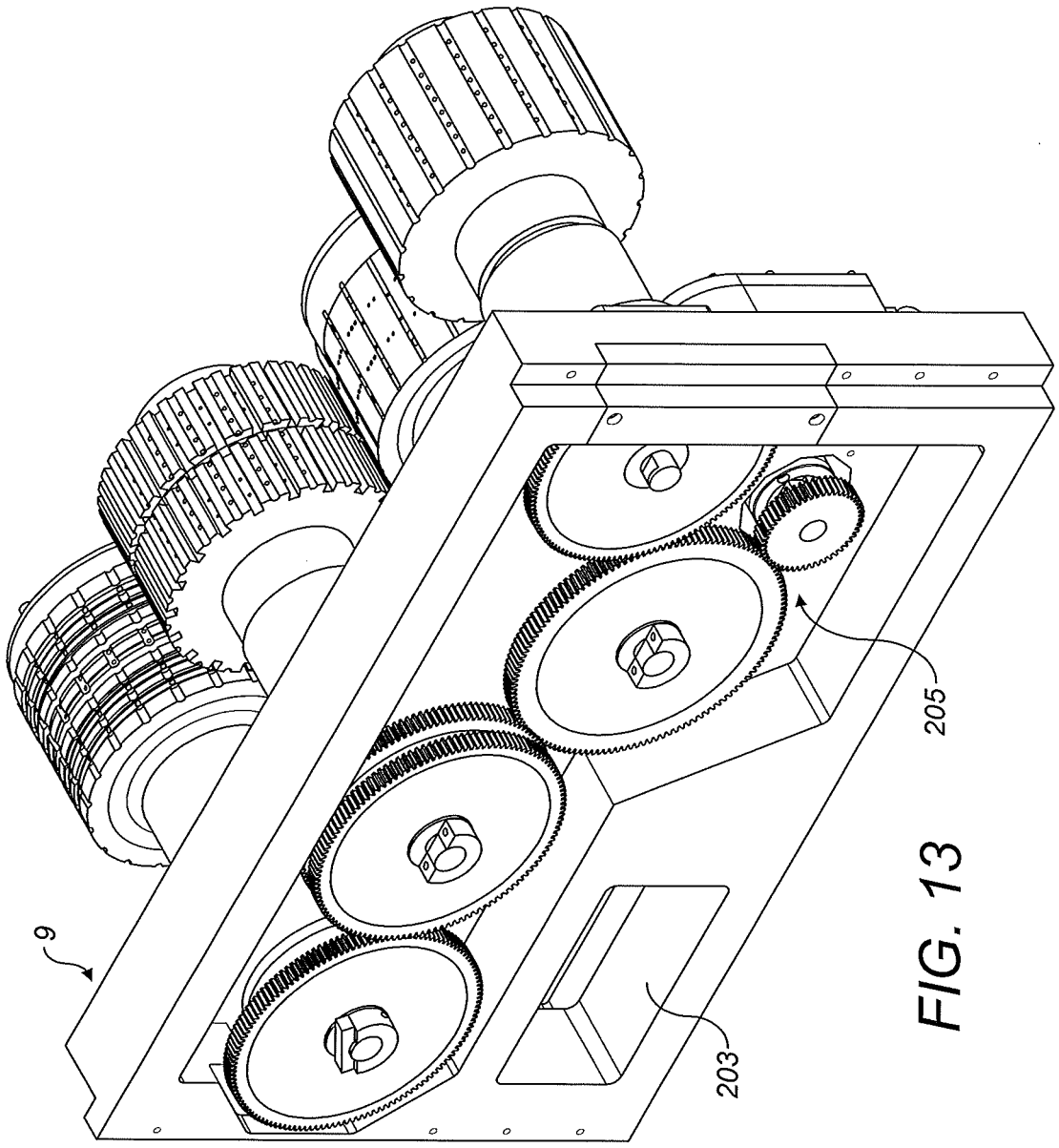

FIG. 13

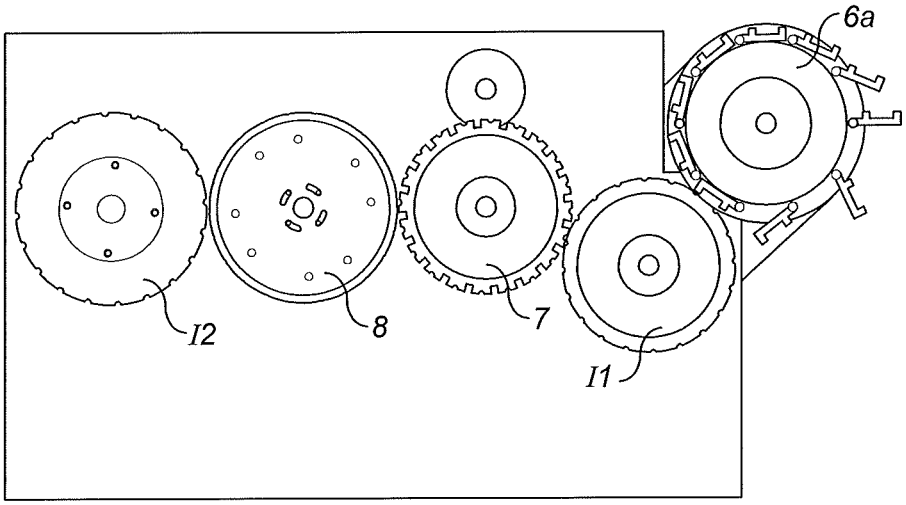

FIG. 14

RELATING TO SMOKING ARTICLE ASSEMBLY

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

RELATED REISSUE APPLICATIONS

Notice: More than one reissue application has been filed for reissue of U.S. Pat. No. 10,772,351. The reissue applications are the present continuation reissue application, and reissue application Ser. No. 17/890,303 filed Aug. 18, 2022.

CROSS REFERENCE TO RELATED APPLICATIONS

This reissue application is a Continuation Reissue Application of Reissue application Ser. No. 17/890,303 filed Aug. 18, 2022, which is a Reissue Application of U.S. Pat. No. 10,772,351, issued Sep. 15, 2020, having Ser. No. 14/649,427, filed Jun. 3, 2015, which is a National Stage of International Application No. PCT/GB2013/053224, filed Dec. 6, 2013, which claims the benefit of Great Britain Provisional Application No. 12220059, filed Dec. 6, 2012, each of which are incorporated herein by reference in their entirety.

FIELD

This invention relates to smoking article assembly and associated machinery. In particular, but not exclusively, it relates to a cigarette assembling machine comprising a plurality of modules.

BACKGROUND

Known filter cigarette assembling machines comprise a filter attachment unit for attaching a filter and tobacco rod to form a filter cigarette. In a known filter attachment unit, a "double length" filter rod (also called a "2-up" rod) is aligned with two tobacco rods at either end, and the three rods are wrapped with a wrapper known as a "tipping paper" so as to join them together. The centrally positioned 2-up filter rod is then cut into two so as to form two filter cigarettes. This process is well known per se to those skilled in the art.

Known filter rods and tobacco rods are conveyed in a filter attachment unit by a plurality of cylindrical drums, with rod articles passing from drum to drum as they are conveyed through the unit. Known drums have a plurality of grooves for holding rod articles during transport, the grooves being spaced around the curved periphery of a drum, with each groove extending in the direction of the drum axis.

Certain drums are configured so that particular operations are carried out as the rod articles are conveyed by the drum. For example known filter attachment machines include a swash plate drum for longitudinally compressing two tobacco rods and a 2-up filter rod before tipping paper is applied, and a rolling drum which co-operates with a roll hand to wrap a tipping paper segment around the three rods. Other known drums include cutting drums which cooperate with a cutting knife to cut rod articles, separating drums for separating rod articles, inspection drums to inspect for the presence of filters or to carry out a leakage test, laser drums to burn small perforations in filter rods, and turning drums to change the orientation of cigarettes. Other known drums include transfer drums (also referred to as "intermediate drums"), takeover drums and feed drums. Known filter attachment machines also include a tipper unit for supplying individual cut segments of tipping paper (known as tipping "patches") and a glue unit for applying glue to the tipping paper.

Known filter attachment units also include a machine controller which controls the drums of the unit. Such controllers can control the acceleration, deceleration and speed of drums and the registration of the rotational position of drums relative to one another, and can also carry out self-diagnosis on the drums.

SUMMARY

In accordance with various embodiments of the present invention, a modular apparatus for smoking article assembly is provided. The modular apparatus is configured to receive rods of smokable material and to cause said received rods of smokable material to undergo a first sequence of operations, wherein the modular apparatus can be reconfigured so as to cause received rods of smokable material to undergo a second sequence of operations, different to the first sequence of operations, wherein the first and second sequences of operations respectively form at least part of first and second processes for assembling smoking articles, each smoking article comprising a said rod of smokable material, which is smoked in use.

The modular apparatus comprises a plurality of modules. Two or more of the modules may be of different types and may have different functions to one another.

In a first configuration, the modular apparatus may comprise a plurality of modules having different functions and may thereby be configured to carry out the first sequence of operations.

The modular apparatus may be reconfigured into a second configuration in which the modular apparatus comprises a plurality of modules having different functions and in which the modular apparatus is configured to carry out the second sequence of operations.

In some examples, all of the modules of the first configuration are of different types to one another. In some examples, all of the modules of the second configuration are of different types to one another.

In various embodiments, the modular apparatus includes a controller configured to control the modules. The controller may comprise a logic controller, e.g: a servo controller with programmable logic control (PLC) functionality.

In various embodiments, the controller is configured to control modules of the modular apparatus in the first configuration and in the second configuration.

In embodiments, the controller is a generic controller. A generic controller is a controller which can control any number of modules up to a module limit for the controller, in any desired module combination.

In various embodiments of the invention, two or more modules of the modular apparatus comprise respective interface units. The controller is configured to control the modules via the interface units. The interface unit of a module comprises input/output electronics to mediate communication between the module and the controller. In some implementations, each of the modules of the modular apparatus comprises a respective interface unit.

In some implementations, each module having an interface unit has one or more drums which can be controlled by the controller via the interface unit. In some implementations, the controller controls a plurality of drums of the module via the interface unit. The controller may control the drums individually, or as a group. The controller may control the acceleration, deceleration and speed of the drums, and the registration of the rotational position of drums relative to one another. In some implementations, the controller controls all of the drums of the module.

In some implementations, each drum of each module has a respective drive mechanism to drive the drum. Each drive mechanism is controlled by the controller via the interface unit for the corresponding module. The drive mechanism for each drum may comprise an integrated servo drive.

In some implementations, the controller may alternatively or in addition carry out suitable self-diagnosis on one or more drums of one or more modules via one or more respective interface units. Self-diagnosis of drums by drum controllers is known per se to those skilled in the art and will not be described here.

In some implementations, the modules receive electrical power from the controller via the interface units.

As will be understood from the foregoing, according to various embodiments, the present invention provides a modular apparatus comprising a plurality of modules, the modular apparatus having a control arrangement comprising a controller and a plurality of interface unit, wherein said plurality of modules are controlled by the main controller via the interface units.

If a new module is added the modular assembly, the interface unit of the new module is connected to the main controller. Similarly, if a module is replaced with a module of a different type, the interface unit of the module to be replaced is disconnected from the controller and the interface unit of the new module is connected

In this way, the modular apparatus can be reconfigured without the need to replace or extensively reconfigure the control arrangement, while maintaining central control of the modules. Thus, the control arrangement facilitates flexible reconfiguration of the modular apparatus.

The control arrangement may comprise a single controller. Each module may have a single interface unit.

In various embodiments, each module of the modular apparatus comprises a separate base unit. The base units of the modules are separable from one another to allow for alternative module arrangements. In this way, the modular apparatus is configured so that modules can be added and/or removed and so that modules can be rearranged relative to one another.

In some embodiments, the modular apparatus includes three modules. In some embodiments, the modular apparatus includes eight modules. In some embodiments, the modular apparatus includes nine modules.

The modular apparatus may comprise a first rod inserter configured to insert a first rod article between two tobacco rods, a first rod divider configured to divide the first rod article into two segments, a rod separator configured to separate a first group comprising a rod of smokable material and one of said segments from a second group comprising a rod of smokable material and another of said segments, and a second rod inserter configured to insert a second rod article between the first and second groups.

According to embodiments of the invention, a flexibly configurable smoking article assembly apparatus is provided which facilitates changes in the assembly process.

The flexibly configurable apparatus may also provide a useful tool in product development. Rather than designing and building a dedicated machine for carrying out a particular sequence of assembly operations, the modular apparatus may be configured to carry out the sequence. Thus, the time and cost to develop new products may be reduced.

Some of the operations of the first sequence of operations may be included in the second sequence of operations. In some examples, the first and second sequences may differ by only one operation. Alternatively, the second sequence of operations may include all of the operations of the first sequence, and may differ in that the second sequence includes one or more further operations not included in the first sequence. Alternatively, the first and second sequences may each consist of the same operations, arranged in a different order. For example, the first and second sequences may differ in that the position of two operations in the first sequence is interchanged in the second sequence. Alternatively, in some examples, none of the operations in the first sequence may be included in the second sequence.

The modular apparatus may comprise a first module comprising said first inserter and a second module comprising said second inserter.

The modular apparatus may further comprise a second rod divider configured to divide the second rod article into two segments. The modular apparatus may further comprise a wrapping station configured to wrap a wrapper at least partially around an inserted rod article after the inserted rod article is inserted between the two tobacco rods and before the inserted rod article is divided by a rod divider. The said inserted rod article may comprise said first rod article inserted by said first inserter, or said second rod article inserted by said second inserter.

The modular apparatus may comprise a plurality of rod inserters, each said rod inserter being configured to insert a rod article between two tobacco rods. The modular apparatus may include a plurality of rod dividers, each said rod divider being configured to divide a rod article into two segments. The modular apparatus may include a plurality of wrapping stations, each said wrapping station being configured to wrap a wrapper at least partially around an inserted rod article after the rod article is inserted between two tobacco rods and before the inserted rod article is divided by a rod divider.

Preferably, the first process for assembling smoking article forms a first configuration of smoking article and the second process for assembling smoking articles forms a second configuration of smoking article different to the first configuration.

The modular apparatus may therefore facilitate changes in the type of cigarette produced. Thus, rather than having separate dedicated machines in a factory to produce different types of cigarette, a single flexible machine is provided. In this way, floor space in the factory can be saved.

The first and second sequences of operations may cause rods of smokable material to be respectively combined with one or more rod articles such as filter rods.

Preferably each rod of smokable material comprises a tobacco rod.

The modular apparatus may include a plurality of modules. The modules may comprise a plurality of functional units configured to cause said rods of smokable material to undergo said first sequence of operations.

Some functional units may for example comprise a conveying element such as a drum, e.g: a swash plate drum, rolling drum, cutting drum, separating drum or transfer

drum. The modules may also include functional units other than drums, for example a tipper unit or glue unit.

The drums are preferably arranged to define a conveyance path through the modular apparatus, along which rods of smokable material are caused to undergo said first sequence of operations.

Reconfiguring the modular apparatus may comprise repositioning modules relative to one another. Alternatively, or in addition, one or more further modules may be added. Alternatively, or in addition, one or more of the modules may be removed.

In some cases where manufacture of a desired cigarette configuration is required, this may be achieved by adding only one further module to the modular apparatus, or by replacing only one module with another module.

The modules may include one or more reconfigurable modules. Reconfiguration of the modular apparatus may comprise reconfiguring a reconfigurable module.

When reconfigured, the modular apparatus preferably comprises a plurality of modules, said plurality of modules comprising a plurality of functional units (e.g: drums) configured to define a conveyance path and cause rods of smokable material to undergo said second sequence of operations.

Preferably, modules are arranged in a row to cause said rods of smokable material to undergo said first and second sequences of operations. Preferably, the modules are arranged in a row by being arranged in a straight line. However, optionally, the modules may be arranged in a row by being arranged in a curved line.

At least one module may be left unchanged when the modular apparatus is reconfigured for said second sequence of operations. For example, an in-feed module configured to receive rods of smokable material may be configured in the same position and in the same way before and after reconfiguration of the modular apparatus.

The modular apparatus may comprise a first group-forming apparatus configured to associate a rod of smokable material with a first rod article to form a first group, and a second group-forming apparatus configured to associate a second rod article with the first group to form a second group. The first group-forming apparatus may be included in a first module and the second group-forming apparatus may be included in a second module.

The modular apparatus may include one or more modules which are linked to a rod attachment unit. Suitable rod attachment units may for example comprise one of a "Max S" unit from Hauni Maschinenbau, a "Max 90" unit, also from Hauni Maschinenbau, or a GD AF12 unit. Other suitable rod attachment units include M5 or M8 filter tip attachment units from Hauni, the GD 121 filter attachment unit, or similar machines. Those skilled in the art will appreciate that other rod attachment units could alternatively be used.

One or more of said rod inserters may be included in the rod attachment unit. The rod attachment unit may be configured to receive at least a tobacco rod from a module of the the modular apparatus, directly or indirectly, and to couple a rod article to the tobacco rod to form a smoking article.

According to various embodiments, a smoking article assembling apparatus comprising one or more modules of the modular apparatus is provided.

The smoking article assembling apparatus may comprise a tobacco rod source. The tobacco rod source may comprise a tobacco rod making unit. Alternatively, the tobacco rod source may comprise a tobacco rod hopper. The modular apparatus may be arranged to receive tobacco rods from the tobacco rod source, directly or indirectly.

At least one of the modules of the modular apparatus may be a reconfigurable module comprising a base unit configured to removably receive a plurality of different parts. The module may comprise a drum-receiving portion adapted to selectively receive first and second drums. The module may comprise a suction control element configured to apply suction to either the first or second drum.

The modular apparatus may comprise some modules which are each configured to receive the same number of drums positioned in the same way. There may be two or more of such modules (e.g: two or more reconfigurable modules). Although the number of drums and their position may be the same for these modules, the drums may be of different types depending on the desired configuration of the modules, so that the functionalities of similarly positioned drums may be different for different modules. In embodiments, all of the modules of the modular apparatus may be configured to receive the same number of drums, positioned in the same way, with the exception of an initial infeed module, which may have a different number of drums.

Each module may comprise a base unit and two or more drums. One or more of the modules may have four drums, or alternatively less than four drums. One or more modules may have more than four drums.

The present invention also provides a kit of parts to assemble the modular apparatus. The kit of parts preferably comprises a plurality of modules.

The present invention also provides a method of reconfiguring the modular apparatus, comprising repositioning modules relative to one another and/or removing one or more modules and/or adding one or more modules and/or reconfiguring one or more of the modules.

The invention also provides an assembler to assemble a smoking article by coupling one or more rod articles to a rod of smokable material which is smoked in use, comprising a first wrapping station to apply a first wrapper to the smoking article and a second wrapping station to apply a second wrapper to the smoking article after the first wrapper has been applied.

A first module may comprise the first wrapping station and a second module may comprise the second wrapping station.

As used herein the term "rod article" includes rods of smokable material such as tobacco rods, filter rods, and also other rod-like articles suitable for inclusion in a smoking article. A rod article may be formed of a single rod, or alternatively may comprise two or more segments.

As used herein the term "filter rod" refers to a rod comprising material suitable for removing certain elements from smoke. The filter rod may be longer than filter elements of the eventual cigarettes. For example, the filter rod may be a "2-up" or "4-up" rod, which is divided into segments during cigarette assembly, each segment being coupled with one tobacco rod in the eventual cigarette. As is known in the art, "2-up filter rod" refers to a filter rod which is intended to be divided into two segments and "4-up filter rod" refers to a filter rod which is intended to be divided into four segments. Similarly, "6-up filter rod" refers to a filter rod which is intended to be divided into six segments.

As used herein, the term "smoking article" includes smokable products such as cigarettes, cigars and cigarillos whether based on tobacco, tobacco derivatives, expanded tobacco, reconstituted tobacco or tobacco substitutes and

also heat-not-burn products. The smoking article may be provided with a filter for the gaseous flow drawn by the smoker.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more fully understood, embodiments thereof will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIG. **1** is a schematic showing elements of a cigarette manufacturing apparatus.

FIG. **1**A shows a module of a first type.

FIG. **2** shows a module of a second type;

FIG. **2**A shows operations performed using the module of FIG. **2**;

FIG. **3** shows a module of a third type;

FIG. **3**A shows operations performed using the module of FIG. **3**;

FIG. **4** shows a module of fourth type;

FIG. **4**A shows operations performed using the module of FIG. **4**;

FIG. **5** shows an arrangement of modules;

FIG. **6**a shows a Max S unit;

FIG. **6**b illustrates a modification to a Max S unit;

FIG. **7** shows an arrangement of modules linked to the modified Max S unit for making a first type of cigarette, and FIG. **7**a illustrates the corresponding cigarette assembly process.

FIG. **8** shows an arrangement of modules for making a second type of cigarette, and

FIG. **8**a illustrates the corresponding cigarette assembly process.

FIG. **9** is a perspective view of the base unit of the modules of FIGS. **2**, **3** and **4** mounted with four drums.

FIG. **10** is the perspective view of FIG. **9**, with one drum removed.

FIG. **11** is a schematic illustrating the regions where suction is applied to the drums, and the direction of rotation of the drums;

FIG. **12** is the perspective view of FIG. **10** with a suction control element and suction housing removed.

FIG. **13** is view of the base unit of FIG. **9** from behind.

FIG. **14** illustrates a variation of the module of FIG. **1**A.

DETAILED DESCRIPTION

FIG. **1** is a schematic showing elements of a cigarette manufacturing apparatus **100**. Apparatus **100** comprises a tobacco rod maker **101** and a cigarette assembly machine **104**. As shown, cigarette assembly machine **104** comprises a modular apparatus, which includes a group **102** of modules **102**a arranged in row, and a filter attachment unit **103**. As shown the modules **102**a of FIG. **1** are positioned between tobacco rod maker **101** and filter attachment unit **103**, and receive tobacco rods directly from tobacco rod maker **101**.

Modules **102** may be configured in different ways to provide different manufacturing options in which different types of cigarette are produced by apparatus **100**. Modules **102** may be reconfigured to produce different cigarette types by adding/removing module(s), repositioning modules relative to one another and/or reconfiguring individual modules. In this way, a flexible cigarette assembly machine is provided which facilitates changes in the type of cigarette produced.

The cigarette manufacturing apparatus **100** includes a control arrangement for electrically controlling the modules of the apparatus. The control arrangement comprises a main cabinet **120**, which acts as the central controller of the control arrangement. The main cabinet **120** includes a logic controller comprising a servo controller with programmable logic control (PLC) functionality, such as a C600 controller. The main cabinet **120** is configured to control the modules **102**a via a plurality of interface units in the form of local cabinets **110**.

As shown in FIG. **1**, each module **102**a has a respective local cabinet **110** in electrical communication with the main cabinet **120**. Each local cabinet **120** comprises input/output electronics to mediate communication between the main cabinet **120** and the module **102**a. Each local cabinet **110** is connected to the main cabinet **120** by one or more cables.

According to various embodiments, each module **102**a comprises a number of servo drive motors to drive components of the module, which are controlled by the main cabinet **120** via the local cabinets **110**. The electronics to drive each servo motor may be provided away from the main cabinet and may be provided on the servo motor itself. Consequently, the controller **120** may comprise a generic controller, which means that it can control any number of modules (up to a module limit for the controller), in any desired module combination.

If a new module is to be added to the group **102**, the new module is positioned appropriately and the local cabinet of the new module is connected to the main cabinet **120**. Similarly, if a module **102**a is replaced with a module of a different type, the local cabinet of the module **120**a which is to be replaced is disconnected from the main cabinet and the new local cabinet **120**a is connected. In this way, the modular apparatus can be reconfigured without the need for replacing or extensively reconfiguring the main cabinet, whilst maintaining central control. Thus, control arrangement of FIG. **1** facilitates flexible reconfiguration of the modular apparatus.

FIGS. **1**A, **2**, **3** and **4** illustrate exemplary modules **1**, **2**, **3**, **4**, and FIGS. **7** and **8** illustrate exemplary configurations of the modular apparatus **102**, **103**. The configuration of FIG. **7** forms cigarettes having triple-segment filters, discussed in more detail below. The configuration of FIG. **8** forms cigarettes having an extendible filter, discussed in more detail below.

FIG. **1**A shows a module **1** of a first type. The module **1** comprises a base unit **5**, which is fitted with a plurality of drums **6**, **7**, **8** for conveying rod articles through the module **1**. The drums **6**, **7**, **8** include a takeover drum **6**, a cutting drum **7** and a separating drum **8**. The takeover drum **6** is configured to receive double-length tobacco rods from a tobacco rod making machine. The tobacco rods are conveyed by the takeover drum and passed to the cutting drum **7**. As shown cutting drum **7** has a circular knife **7**a configured to cut each double length rod into two tobacco rods, which are fed from the cutting drum to separating drum **8**. Separating drum **8** is configured to longitudinally separate the two tobacco rods and then feed them out of the module **1**. Separating drum **8** is of a known type having four segments on each side which have cam followers running in a track cam. The segments holding the tobacco rods can move from inner to outer position to create a gap between the tobacco rods. Although not shown in FIG. **1**A, the module **1** includes a local cabinet **110** comprising interface electronics configured to allow control of the module drums **6**, **7**, **8** by the main cabinet **120**. In various embodiments, the main cabinet **120** can control the acceleration, deceleration and speed of the drums **6**, **7** **8** and the registration of the

rotational position of the drums relative to one another, and can also carry out self-diagnosis on the drums.

FIG. **2** shows a module **2** of a second type. As shown, this module **2** includes a base unit **9**, which is fitted with a feed drum **10**, a cutting drum **11** and circular knife **11**a, an intermediate drum **12** and a separating drum **13**. As shown, drums **10**, **11**, **12**, **13** form a conveyance path for rod articles through the module **2**.

The module **2** is configured to cut a central rod in a group of received rod articles into two segments, and to then separate the cut segments to form two spaced rod groups.

As illustrated in FIG. **2**a, the module **2** may receive two tobacco rods **14** together with a centrally positioned filter rod **15**, e.g. from a preceding module, such that the three rods are aligned with one another in a groove of the feed drum **10**. In this case, the feed drum **10** conveys the three aligned rods into a groove of cutting drum **11** in which the central filter rod **15** is cut into two segments **15**a, **15**b. The separating drum **13** then separates the rods into two groups such that each group includes one cut segment **15**a, **15**b and one tobacco rod **14**. Both groups are then fed out of the module **2** by the separating drum **13**. Although not shown in FIG. **2**, the module **2** includes a local cabinet **110** comprising interface electronics configured to allow control of the module drums **10**, **11**, **12**, **13** by the main controller **120**. In various embodiments, the main cabinet **120** can control the acceleration, deceleration and speed of the drums **10**, **11**, **12**, **13** and the registration of the rotational position of the drums relative to one another, and can also carry out self-diagnosis on the drums.

In some exemplary configurations, rather than receiving two tobacco rods together with a single centrally positioned filter rod, the module **2** may alternatively be configured to receive two tobacco rods together with three filter rods positioned centrally between the tobacco rods. In this case, the cutting drum **11** may be configured to cut the central filter rod at a central point into two segments and the separating drum **12** may be configured to separate the rods into two groups such that each group includes one of the cut segments, one rod which has not been cut by the cutting drum **11**, and one tobacco rod.

It will be appreciated that in other configurations, the module **2** may receive two tobacco rods together with five filter rods, or another odd number of filter rods. In some examples, the centrally positioned filter rod or rods may be attached to the tobacco rods (and/or one another) with one or more wrappers when received by the module **2**.

In some embodiments, some or all of the filter rods may be multi-segment filter rods. Alternatively, the filter rods may be single-segment rods.

FIG. **3** shows a module **3** of a third type. The module **3** of FIG. **3** is the same as the module **2** of FIG. **2**, except that the module **3** further comprises a filter feed mechanism **16**. Thus, the same reference numerals are retained for corresponding features. The module **3** acts to receive two tobacco rods which are longitudinally separated by a gap, insert a filter rod into the gap, cut the inserted filter rod into two segments and then separate the cut segments to form two spaced rod groups. As with the module **2**, the module **3** includes a local cabinet **110**. to allow control of the drums **10**, **11**, **12**, **13** by the main cabinet **120**.

Suitable filter feed mechanisms **16** for the module **3** are known per se. For example, feed mechanisms from known "Max S" and "Max 90" machines may be used. The filter feed mechanism may be arranged to output a desired type of rod article, for example 2-up, or alternatively 4-up filter rods. As shown in FIG. **3**, the feed mechanism **16** has an input **17** for receiving filter rods and an output **18** located for feeding filter rods onto the feed drum **10**. The filter feed may also include a cutting mechanism to cut each received rod into filter two rod segments, which are then fed onto the feed drum. For example, the filter feed mechanism may receive 4-up rods, cut each 4-up rod into two 2-up rods and then feed each 2-up rod onto the feed drum. Alternatively, the filter feed mechanism may receive filter rods of a different length, for example 6-up rods, and in some configurations cut the received rods to make segments of a desired length.

Thus, the module **3** may receive tobacco rods from a preceding module, and also filter rods from the feed mechanism **16**. The tobacco rods are received on the feed drum spaced by a suitable gap, the gap being sized to receive a rod article from the feed mechanism **16**.

As illustrated in FIG. **3**a, in some configurations, a groove of the feed drum **10** may receive two aligned tobacco rods **14** from a preceding module, the tobacco rods being separated by a gap. The filter feed mechanism may be configured to place a 2-up filter **15** in the gap as the tobacco rods are being conveyed by the feed drum. The cutting drum **11** is configured to cut the inserted filter rod **15** centrally and the separating drum **12** is configured to separate the rods into two groups such that each group includes a filter segment **15**a and one tobacco rod **14**. The two groups are then fed out of the module **3**.

In other configurations, the module **3** may receive two tobacco rods together with two filter rods from a preceding module so that the four rods are aligned in a groove of the feed drum **10**. The rod articles may be received with a central gap sized for receiving a further "2-up" filter rod. In this case, the module **4** may be configured to 1) insert a 2-up filter in the gap, 2) cut the inserted filter rod into two rods and then 3) separate the rods into two groups such that each group includes a cut segment of the inserted rod, one of the filter rods received from the previous module, and one of the tobacco rods.

FIG. **4** shows a module **4** of a fourth type. As shown, the module **4** includes a base unit **9**, which is fitted with a filter feed **16**, a feed drum **19**, a swash plate drum **20**, a rolling drum **21**, a roll hand **22**, a transfer drum **23**, a tipper unit **24** and a glue unit **25**. The module **4** is configured to insert a rod article such as a filter rod between two received tobacco rods, and to apply a wrapper in the form of a tipping paper.

As illustrated in FIG. **4**a, the feed drum **19** may receive two tobacco rods from a preceding module. The tobacco rods may be separated by a gap sized to receive a "2-up" filter rod. The filter feed is arranged to fit a 2-up filter rod into the gap. The swash plate drum **20**, rolling drum **21**, roll hand **22**, tipper unit **24** and glue unit **25** then cooperate to wrap the three rods with a tipping paper to join them together, in a manner which is well known to those skilled in the art. In more detail, the swash plate drum acts to longitudinally compress the three rod articles, and a glue lined patch of tipping paper is then applied on the rolling drum to join the three rod articles together. The joined group of two tobacco rods and one double length filter rod are then fed out of the module **4** by the transfer drum **23**.

Although not shown in FIG. **4**, the module **4** includes a local cabinet **110** to permit control of the module drums **19**, **20**, **21**, **23** by the main cabinet **120**. In various embodiments, the main cabinet **120** can control the acceleration, deceleration and speed of the drums **19**, **20**, **21**, **23** and the registration of the rotational position of the drums relative to one another, and can also carry out self-diagnosis on the drums.

As mentioned above, the tipper unit **24**, glue unit **25** and rollhand **22** are well known components per se, but a brief description of these components will nonetheless now be given.

Tipper Unit

The tipper unit **24** has carbide knives cutting against a carbide drum, which cuts the tipping paper to a required length. The tipping patches are then transferred by the carbide drum (tipping drum) onto the cigarettes. The length of the tipping patches is determined by the feed roller which is mounted before the glue unit, and can be varied. The patch length is usually equal to the cigarette circumference plus about 2 mm. The tipper unit can apply patches of different widths depending on the width of the tipping paper used.

Glue Unit

The glue unit **25** includes a glue roller which runs in the glue. This roller then transfers the glue to the transfer roller. The paper runs over the transfer roller to transfer the glue from the roller to the paper.

Rollhand/Rolling Drum

The rollhand **22** is a static curved block which sits below the rolling drum **21**. When the cigarettes, which are on the rolling drum, get to the entry point of the roll hand a scraper pushes the cigarette out of the groove and it is then rolled between the drum and roll hand till the cigarette falls into the next groove.

Rather than receiving two spaced tobacco rods, in some configurations the module **4** may receive two tobacco rods together with two filter rods, the rod articles being received from a preceding module. The received filter rods may be separated by a gap sized to receive a further 2-up filter. The feed mechanism **16** may be arranged to insert a 2-up filter into the gap. In this case the swash plate drum acts to compress the five rod articles together and the inserted rod is wrapped with a tipping paper on the rolling drum to join it to the rods received from the previous module.

In some configurations, the module **4** may apply tipping in two separated bands. The configuration for applying banded tipping is the same as for application of conventional tipping, but a slitting knife is also included to split the single tipping band into 2 bands. Also, paper guides are provided to open the two bands to the required positions before gluing. The tipping band is slit after the splicing unit and scraper (not shown), at a position before the glue applicator.

In embodiments, the filter rods which are inserted by the modules **2**, **4** may comprise multiple segments, ie: they may comprise multi-segment rods formed for example of a central "double length" rod segment with two "single length" rod segments to either side of the central segment. Alternatively however, in some embodiments the filter rods which are inserted may be single-segment rods.

The modules described above may be linked together in different arrangements to provide different sequences of operations for forming the same or different types of cigarettes. The final drum of one module may be aligned with the initial drum of the next module so that rods pass from the out-feed of one module to the in-feed of the next.

Still further flexibility can be achieved by reconfiguring individual modules. The modules **2**, **3** and **4** of FIGS. **2** to **4** share a base unit **9** having four drum-receiving shafts, each adapted for removably receiving a drum. Thus, each of the drums on the modules **2**, **3** and **4** may be replaced with another suitable drum so as to vary the functionality of the module. For example, the cutting drum **11** of FIG. **2** can be replaced with a transfer drum or a swash plate drum. The intermediate transfer drum **12** of FIG. **2** can be replaced with a rolling drum, transfer drum, ejection drum, laser drum or other suitable drum. Other components may also be added/removed, for example a filter feed, tipper unit, gluing unit, rolling device and a laser for laser perforation.

The module **2** of the second type can thus be converted to a module **3** of the third type by a reconfiguration process comprising adding a filter feed **16**. Furthermore, the module **3** of the third type can be converted to a module **4** of the fourth type by a reconfiguration process comprising replacing the cutting drum **11** with a swash plate drum **20**, replacing the intermediate transfer drum **12** with a rolling drum **21**, replacing the separating drum **13** with a transfer drum, and adding the tipper unit **24**, the glue unit **25** and the roll hand **22**.

In replacing a drum on the base unit **9**, a replacement drum typically has the same number of grooves as the drum which it replaces. In FIGS. **2**, **3**, **4**, the first drum **10**, **19** may have 20 grooves, the second drum **11**, **20** may have 20 grooves, the third drum **12**, **21** may have 22 grooves and the fourth drum **13**, **23** may have 20 grooves.

FIG. **9** is a perspective view showing the base unit **9** fitted with a feed drum **19**, swash plate drum **20**, roll drum **21** (and roll hand **22**), and transfer drum **23**. As shown, each drum **19**, **20**, **21**, **23** is mounted on a shaft **19**a, **20**a, **21**a, **23**a which rotates the drum. As illustrated in FIG. **10**, each drum can be unscrewed and detached from its shaft so that another drum can be alternatively fitted.

As shown in FIGS. **9** and **10**, the base unit **9** include a suction housing **200** which applies suction for holding rod articles on the drums **19**, **20**, **21**, **23** and for transferring rod articles from one drum to the next. Referring to FIG. **10**, suction housing **200** is in communication with suction control elements **201**, which each have a suction outlet **202** shaped to selectively apply suction to appropriate points during rotation of the corresponding drum.

FIG. **11** is a schematic which illustrates with shading the regions in which suction is applied by the suction control elements, and the direction of rotation of the drums **19**, **20**, **21**, **23**.

Some drums may be replaced without changing the suction control element. For example, the intermediate drum **12** of the module **2** may be replaced by a cutting drum **11** without changing the suction control element. In some cases however the suction element may be changed before a new drum is fitted.

FIG. **12** shows the base unit **9** with drum **19** and its suction control element **201** removed, and with the suction housing **200** also removed. As shown, vacuum may be applied to suction housing **200** via a hole **203** in the base unit **9**.

Each drum may be driven by a respective servo drive motor. Those skilled in the art cognizant of the present disclosure will appreciate that the servo motor may be connected to its respective drum by a gearbox and a coupling to turn the drum.

The servo drive motor for each drum is an integrated servo drive. Integrated servo drives are known per se and will not be described in detail. Briefly, in an integrated servo drive, the electronics to drive the motor is integrated with the motor.

The interface electronics of the local cabinet **110** of the module is configured to transfer control signals from the main controller to appropriate servo drive motors to control the module drums. The servo driver motors for each drum may thus be individually controlled by the main cabinet **120** via the interface electronics of the local cabinet **110** of the module. It will be appreciated that the servo drives may also send signals, e.g: status or diagnostic signals back to the main controller.

FIG. **13** is a rear view showing an alternative scheme for driving the drums of the base unit **9**. As shown, in this example the base unit includes a gearbox **205** configured to turn the four drums synchronously. In use, one of the shafts is driven by a servo motor (not shown) to turn the drums. The servo motor may receive control signals from the main controller **120** via the local cabinet **110** of the module.

Turning again to FIG. **9**, as shown the base unit **9** has a joining member **204** at either end to overlap with complementary joining members on other modules. The joining members **204** ensure that the final drum on one module is automatically aligned with the first drum of the next module when two modules are engaged together.

FIG. **5** shows one possible configuration of modules **26**, in which modules **2**, **4**, **3**, **1** of the second, fourth, third and first type are arranged one after the other in a row. As described above, each module may include one or more servo motors to drive the drums. Other components, e.g: tipper unit, glue unit, may be driven by further servo motors. These further servo motors may be controlled by the main cabinet **120** via the local cabinets **110** of the modules, in the same manner in which the servos which drive the drums are controlled.

Those skilled in the art, cognizant of the present disclosure will appreciate that self-diagnosis and safety features of the module components may also be controlled by the main cabinet via the local cabinets.

In some embodiments, the main cabinet also provides electrical power via the local cabinet **110** to power the servo drive motors. In some embodiments, the modules may include one or more sensors, and the electrical output of the sensors may be provided to the main cabinet **120** via the local cabinet **110**.

In various embodiments, the local cabinet **110** of each module is connected to the main cabinet **120** by one or more cables. For example, one cable may carry control signals (input/output signals) and another cable may carry electrical power. Those skilled in the art will appreciate that further cables may also be provided for example for 3-phase and Ethernet communication.

According to various embodiments, local cabinets may be easily connected/disconnected from the main cabinet by connecting/disconnecting the respective cables.

In embodiments, the servo motors of each module may be synchronised with one another so that rotation of all of the drums in a particular arrangement is synchronised. Servo motors driving other components may also be appropriately synchronised with the servo modules used to drive the module drums.

The combination of modules **26** may be linked to a filter attachment unit such as a modified Max S unit to carry out further processing. FIG. **6**a illustrates a commercially available Max S machine **27** and FIG. **6**b illustrates a modified machine **28** adapted for use with the modules **1**, **2**, **3**, **4**. As shown, the modified machine **28** of FIG. **6**b differs from the known machine **27** only in that the infeed section **27**a is removed in the modified machine **28**.

Since the modified unit **28** differs from the known unit **27** only by the absence of the infeed unit **27**a, it will not be described in any further detail here.

Although FIGS. **6**a and **6**b show a modified Max S, any filter attachment unit could alternatively be linked to the modules, for example a commercially available machine such as a GD AF12 or a Max 90 unit modified in a similar manner as described above, i.e.: by removing the infeed section. Where a Max 90 is used for example, the modified unit can carry out all of the functions of a Max 90, which include: addition of a filter rod, tipping application and rolling, laser perforation, cutting, turning cigarettes, inspections and a link-up to a tray filler.

FIG. **7** shows an arrangement of successive modules **29** linked to a modified Max S unit **28** for making a particular type of cigarette. As shown, the arrangement **29** includes a module **1** of the first type, a module **3** of the third type, a module **4** of the fourth type and a module **2** of the second type, arranged successively in a row and linked to a modified Max S unit **28**. The first module **1** receives a "double length" tobacco rod from a tobacco rod maker (not shown), and the received tobacco rod is caused to undergo a sequence of operations in the modules **1**, **3**, **4**, **2** and subsequently in the Max S unit **28** to form a filter cigarette **30**. As shown in FIG. **7**a, the eventual cigarette **30** includes a triple segment filter and is wrapped with two separate tipping papers separated longitudinally by a gap **31**.

FIG. **7**a illustrates the sequence of operations carried out by the machinery of FIG. **7**. Each box in FIG. **7**a illustrates the operations which occur in one of the modules. As shown, each box is labelled with the reference sign of one of the modules **1**, **3**, **4**, **2** to indicate that the operations illustrated in the box occur in the referenced module.

Referring to FIG. **7**a, in the module **1**, a "double length" tobacco rod **32** is received from a tobacco rod maker (not shown) and cut into two equal segments **32**a, **32**b. The two segments are then separated and the separated segments are fed into the next module **3**.

In the module **3**, a 2-up filter rod **33**, supplied by the module's filter feed mechanism, is inserted in the gap between the two separated tobacco rods **32**a, **32**b received from the module **1**. The filter **33** is then cut centrally into two segments **33**a, **33**b. A first group **34**a comprising one tobacco rod **32**a and one filter rod segment **33**a is then separated from a second group **34**b comprising one tobacco rod **32**b and one filter rod segment **33**b, and the two separated groups **34**a, **34**b are fed onto the first drum of the next module **4**.

In the next module **4**, a further filter rod **35** is added in the gap between the two separated groups **34**a, **34**b. The module **4** then applies tipping in two separated bands **36**a, **36**b. The first band **36**a is wrapped around the tobacco rod **32**a, the rod segment **33**a and the further rod **35** to join these three rods together. The second band **36**b is wrapped around the tobacco rod **32**b, the rod segment **33**b and the further rod **35** to join these rods together. Thus, filter **35** is joined to a filter segment **33**a from the first group **34**a and to a segment **33**b from the second group **34**b by wrapping with the bands **36**a, **36**b. The wrapped rods **34**a, **34**b, **33**a, **33**b, **35** are then fed to the next module.

In the next module **2**, the centrally positioned double length filter rod **35** is cut into two segments **35**a, **35**b. A first group of rods G**1** comprising a filter rod segment **33**a, a filter rod segment **35**a and a tobacco rod **32**a is then separated from a second group of rods G**2** comprising a filter rod segment **33**b, a filter rod segment **35**b, and a tobacco rod **32**b. The separated groups G**1**, G**2** are then fed to the first drum of the modified Max S machine **28**, as shown in FIG. **7**.

As illustrated in FIGS. **7** and **7**a, the modified Max S unit has a filter feed **38** which inserts a 2-up filter rod **37** between the group G**1** and the group G**2**. The 2-up filter rod **37** is then joined to the filter rod segment **35**a of the group G**1** and to the filter rod segment **35**b of the group G**2** by wrapping with a single wrapper **39**. The wrapper **39** is sized so that it does not overlap with the bands **36**a, **36**b. Instead, the wrapper **39** is sized so that there is a gap **31** between each end of the wrapper **39** and the bands **36**a, **36**b.

The wrapped 2-up filter rod **37** is then cut centrally into two segments **37**a, **37**b to form two cigarettes **30** which are turned so as to adopt a parallel configuration. As shown, the two cigarettes **30** are identical, and each includes three filter segments **37**a, **35**a, **33**a and two wrappers, the wrappers being longitudinally separated by a gap **31**.

FIG. **8** shows an alternative configuration **40** of successive modules for making a different type of cigarette **41**. The eventual cigarette **41** is of the extendible (telescopic) type, in which two filters can be separated by a variable amount by sliding an outer sleeve. Telescope cigarettes are known per se, from for example FR 1547656.

As shown, the configuration **40** comprises six modules **51**, **52**, **53**, **54**, **55**, **56**.

The first module **51** is the same as the module **1** of FIG. **1**A.

The second module **52** is the same as the module **4** of FIG. **4**.

The third module **53** comprises a modified version of the module **2** of FIG. **2**. The third module **54** is different to the module **2** of FIG. **2** in that the first drum (feed drum **10**) has been replaced with a cutting drum, the second drum (cutting drum **11**) has been replaced with a separating drum, and the fourth drum (separating drum **13**) has been replaced with an inspection drum to inspect for the presence of filters.

The fourth module **54** is the same as the module **4** shown in FIG. **4**.

The fifth module **55** comprises a modification of the module **4** shown in FIG. **4**. The module **55** is different to the module **4** in that the filter feed **16** has been removed and in that the fourth drum (transfer drum **23**) is replaced with a laser drum to form perforations in the cigarette.

The sixth module **56** is a module comprising four drums **56**a, **56**b, **56**c, **56**d. The first drum **56**a is a cutting drum, the second drum **56**b is a transfer drum, the third drum **56**c is a turning drum and the fourth drum **56**d is an inspection drum configured to perform a leakage test on the cigarettes. The turning drum is known per se, and may be configured to turn the front row of cigarettes over to have the same orientation as the rear row, or may alternatively be configured to turn the rear row of cigarettes over to have the same orientation as the front row.

A further module may also be provided (not shown) including final end scanners and an ejection drum which serves as a link-up to further downstream machines.

FIG. **8**a illustrates the sequence of operations carried out the form the cigarette **41**. Each box in FIG. **8**a illustrates the operations which occur in one of the modules **51**, **52**, **53**, **54**, **55**, **56**. As shown, each box is labelled with the reference sign of one of the modules **51**, **52**, **53**, **54**, **55**, **56** to indicate that the operations illustrated in the box occur in the referenced module.

As shown, the module **51** is an infeed module configured to receive "double length" tobacco rods **60**, for example from a tobacco rod maker. In the module **51**, each tobacco rod **60** is cut into two segments **60**a, **60**b, which are separated and fed into the next module **52**.

The next module **52** is configured to insert a 2-up filter rod **61** between the separated tobacco rods received from the module **52**, and to wrap the three rods **60**a, **60**b, **61** with a wrapper **62** to join them together. The wrapped rods are then fed into the next module **53**.

The next module **53** is configured to cut the filter rod **61** into two segments **61**a, **61**b, and to separate the segments to form two groups, each comprising a tobacco rod **60**a, **60**b joined to a filter rod segment **61**a, **61**b. Each group forms an inner cigarette C of an eventual extendible cigarette **41**. The inspection drum then carries out an inspection for the presence of filters. The separated inner cigarettes C are then fed to the next module **54**.

The next module **54** is configured to insert a further filter rod **63** between the filter segments **61**a, **61**b and to wrap a wide tipping paper patch **64** around the tobacco rods **60**a, **60**b, the filter rod segments **61**a, **61**b and the filter rod **63**. The glue unit is configured to apply glue to the tipping patch **64** so that the tipping patch **64** is only glued to the centre filter rod **63** and on the overlap of the tipping, so as to form a tube which is only attached to the centre rod **63**. The wrapped rods are then fed to the next module **55**.

The next module **55** is configured to apply a further tipping patch **65** around the tipping patch **64** so that it overlaps with the tipping patch **64**. The laser drum then applies a pulsed beam to make small perforations through the tipping layers **64**, **65**.

The next module **56** is configured to cut the filter **63**, through the tipping layers **64**, **65** so as to divide the filter **63** into two segments **63**a, **63**b and thus form two extendible cigarettes **41**a, **41**b. The turning drum then turns the two cigarettes **41**a, **41**b so that they are parallel to one another.

As described above, the inner cigarette C of each extendible cigarette **41**a is not glued to the tipping layers **64**, **65**, so that the inner cigarette C can be slid in the tube formed by the tipping layers **64**, **65** to vary the separation between the filter rod **61**a, **61**b and the filter rod **63**a, **63**b.

The modules can be reconfigured to vary the cigarette assembly process as desired, for example by replacing one or more of the drums. Also, the modules can be repositioned relative to one another and/or one or more modules may be added/removed so as to provide yet further cigarette assembly options.

Many further modifications and variations are possible. For example, although the module **1** of FIG. **1**A receives "double length" tobacco rods one at a time from a tobacco rod maker, in some example multiple "double length" tobacco rods may be received at a time, for example from a "double track" tobacco rod maker. FIG. **14** shows a variation of the module **1** of the first type for use with a "double track" tobacco rod maker which makes two tobacco rods at a time. As shown, the modified module **1** of FIG. **14** has a modified take over drum **6**a for receiving the two tobacco rods, and two additional intermediate transfer drums I**1**, I**2**. As shown, the takeover drum **6**a has a plurality of pivoted arms, which each swing out sequentially in use to collect two tobacco rods from the maker. As the drum rotates further in an anticlockwise direction, the arms fall back into position against the drum. As illustrated in FIG. **14**, the arms then deliver tobacco rods one at a time to the first intermediate transfer drum I**1**.

Other modules may also be included in certain configurations to carry out other operations. For example, a discharge module may be included in some arrangements to discharge assembled rod articles at different heights. The discharge module may be configured to discharge rods articles at a particular height for linking to a mass flow feed, for example to a conveyor to carry discharged rod articles to further machinery for further processing. Alternatively, the discharge height may be varied when discharge to a packaging machine is required, or when discharge to a tray filler for storage is required.

Further, although coupling filter rods to tobacco rods is described above, in some configurations a module may insert a component other than a filter rod, e.g: a rod article such as a tobacco rod, or a rod element comprising one or more plastic elements, e.g: twistable elements having first

and second parts which can be rotated relative to one another to change the characteristics of a smoking article, as described for example in EP0395291A1.

According to various embodiments of the present invention, modules may carry out one or more of the following operations: transfer, insert separate, wrap, rotate, inspect, reject, press-together, laser-cut, turn, sample cigarettes for test, roll tipping. In embodiments, each module carries out two or more of these operations. Each individual operation may be carried out by a single functional unit (e.g: by a single drum).

As will be appreciated from the foregoing, the drums of the modules may be selected so that each module carries out a selected sequence of assembly operations. Also, the number of modules and their relative position may be chosen so that the modules carry out their respective assembly operations sequentially in a selected order.

In order to address various issues and advance the art, the entirety of this disclosure shows by way of illustration various embodiments in which the claimed invention(s) may be practiced and provide for superior apparatus and methods. The advantages and features of the disclosure are of a representative sample of embodiments only, and are not exhaustive and/or exclusive. They are presented only to assist in understanding and teach the claimed features. It is to be understood that advantages, embodiments, examples, functions, features, structures, and/or other aspects of the disclosure are not to be considered limitations on the disclosure as defined by the claims or limitations on equivalents to the claims, and that other embodiments may be utilised and modifications may be made without departing from the scope and/or spirit of the disclosure. Various embodiments may suitably comprise, consist of or consist essentially of various combinations of the disclosed elements, components, features, parts, steps, means, etc. In addition, the disclosure includes other inventions not presently claimed, but which may be claimed in future.

The invention claimed is:

[1. A modular apparatus for smoking article assembly, comprising:

a plurality of modules having a plurality of respective interface units, and

a controller configured to control said plurality of modules via said interface units,

wherein the modular apparatus is configured to cause received rods of smokable material to undergo a first sequence of operations,

wherein each said module comprises one or more drums and the controller controls said one or more drums of each said module via the interface unit of its module, and

wherein the modular apparatus can be reconfigured by replacing at least one of said drums of at least one of said plurality of modules so as to cause received rods of smokable material to undergo a second sequence of operations, different to the first sequence of operations, and

wherein the first sequence of operations and the second sequence of operations respectively form at least part of first and second processes for assembling smoking articles, each smoking article comprising a said rod of smokable material, which is smoked in use.]

[2. The modular apparatus for smoking article assembly as claimed in claim 1, wherein each said drum has a respective drive mechanism, wherein each of said drive mechanisms is controlled by the controller via the interface unit of its module.]

[3. The modular apparatus as claimed in claim 2, wherein each of said drive mechanisms comprises an integrated servo drive.]

[4. The modular apparatus as claimed in claim 1, wherein the modules receive electrical power from the controller via the interface units.]

[5. The modular apparatus according to claim 1, further comprising:

a first inserter configured to insert a first rod article between two tobacco rods; a first rod divider configured to divide the first rod article into at least two parts, a separator configured to separate a first group comprising a rod of smokable material and one of said parts from a second group comprising a rod of smokable material and another of said parts, and

a second inserter configured to insert a second rod article between the first and second groups.]

[6. The modular apparatus as claimed in claim 5, further comprising:

a second rod divider configured to divide the second rod article into at least two parts; and

a wrapping station configured to wrap a wrapper at least partially around an inserted rod article after the inserted rod article is inserted between the two tobacco rods and before the inserted rod article is divided by a rod divider.]

[7. The modular apparatus as claimed in claim 5, wherein the modular apparatus comprises a first module comprising said first inserter, and a second module comprising said second inserter.]

[8. The modular apparatus as claimed in claim 1, comprising:

a plurality of inserters, each said inserter being configured to insert a rod article between two tobacco rods;

a plurality of rod dividers, each said rod divider being configured to divide a rod article into at least two parts, and

a plurality of wrapping stations, each said wrapping station being configured to wrap a wrapper at least partially around an inserted rod article after the rod article is inserted between two tobacco rods and before the inserted rod article is divided by a rod divider.]

[9. The modular apparatus as claimed in claim 1, wherein the modular apparatus includes a plurality of modules of different types having different functions.]

[10. The modular apparatus as claimed in claim 1, wherein the modular apparatus includes two or more modules, each having a separate base unit and one or more drums, wherein each of said two or more modules is configured to receive the same number of drums.]

[11. The modular apparatus as claimed in claim 10, wherein each of said two or more modules are configured to receive drums in corresponding positions with respect to the respective base unit.]

[12. The modular apparatus as claimed in claim 1, wherein said first process for assembling smoking articles forms a first configuration of smoking article and wherein said second process for assembling smoking articles forms a second configuration of smoking article different to the first configuration.]

[13. The modular apparatus as claimed in claim 1, wherein said first sequence of operations and said second sequence of operations cause rods of smokable material to be respectively combined with one or more rod articles.]

[14. The modular apparatus as claimed in claim 1, comprising a plurality of modules configured to receive said rods

of smokable material, said plurality of modules comprising a plurality of functional units configured to conduct said first sequence of operations.]

[15. The modular apparatus as claimed in claim 14, wherein said functional units comprise a plurality of conveying elements arranged to define a conveyance path through the modular apparatus, along which rods of smokable material are caused to undergo said first sequence of operations.]

[16. The modular apparatus as claimed in claim 1, wherein said

modular apparatus can be reconfigured by repositioning modules relative to one another and/or removing one or more of the modules and/or adding one or more further modules.]

[17. The modular apparatus as claimed in claim 1, wherein said plurality of modules comprise a reconfigurable module, wherein reconfiguration of the modular apparatus comprises reconfiguring said reconfigurable module.]

[18. The modular apparatus as claimed in claim 1, wherein when

reconfigured, the modular apparatus comprises a plurality of modules, said plurality of modules comprising a plurality of functional units configured to conduct said second sequence of operation.]

[19. The modular apparatus as claimed in claim 1, wherein modules are arranged in a row to cause said rods of smokable material to undergo said first sequence of operations and said second sequence of operations.]

[20. The modular apparatus as claimed in claim 1, wherein at least one module is left unchanged when the modular apparatus is reconfigured for said second sequence of operations.]

[21. The modular apparatus as claimed in claim 20, wherein said at least one module which is left unchanged comprises an in-feed module configured to receive rods of smokable material.]

[22. The modular apparatus as claimed in claim 1, wherein each module comprises one or more servo motors and wherein said servo motors are synchronized.]

[23. The modular apparatus as claimed in claim 1, wherein the modular apparatus comprises a first group-forming apparatus configured to associate a rod of smokable material with a rod article to form a first group, and a second group-forming apparatus configured to associate a rod article with the first group to form a second group.]

[24. The modular apparatus as claimed in claim 23, wherein the modular apparatus comprises a first module comprising said first group-forming apparatus and a second module comprising said second group-forming apparatus.]

[25. The modular apparatus as claimed in claim 1, comprising a first wrapping station to apply a first wrapper to the smoking article and a second wrapping station to apply a second wrapper to the smoking article after the first wrapper is applied.]

[26. The modular apparatus as claimed in claim 25, wherein the second wrapping station is configured to apply the second wrapper so that it overlaps with the first wrapper.]

[27. The modular apparatus as claimed in claim 25, wherein the second wrapping station is configured to apply to the second wrapper so that there is a longitudinal gap between the first wrapper and the second wrapper.]

[28. The modular apparatus as claimed in claim 25, wherein the first wrapping station is included in a first module and the second wrapping station is included in a second module.]

[29. A smoking article assembling apparatus comprising a modular apparatus as claimed in claim 1.]

[30. The smoking article assembling apparatus as claimed in claim 29, further comprising a tobacco rod source, wherein the modular apparatus is arranged to receive tobacco rods from the tobacco rod source.]

[31. The smoking article assembling apparatus as claimed in claim 30, wherein the modular apparatus is arranged to receive tobacco rods directly from the tobacco rod source.]

[32. The modular apparatus of claim 1, wherein at least one of the plurality of modules is a reconfigurable module comprising a base unit configured to removably receive a plurality of different parts.]

[33. The modular apparatus as claimed in claim 32, wherein in a first configuration of the reconfigurable module, the base unit is fitted with a rod-receiving component to receive a group of rod articles, a rod-cutting component to cut a central rod in said group of received articles into two segments, and a rod-separating component to separate the segments, thereby to form two spaced rod groups.]

[34. The modular apparatus as claimed in claim 33, wherein in a second configuration of the reconfigurable module, the base unit is fitted with a rod-receiving component to receive two tobacco rods which are longitudinally separated by a gap, a rod-insertion component to insert a rod article in the gap, a rod-cutting component to cut an inserted rod article into two segments, and a rod separating component to separate the segments, thereby to form two spaced rod groups.]

[35. The modular apparatus as claimed in claim 34, wherein in a third configuration of the reconfigurable module, the base unit is fitted with a rod-receiving component to receive two tobacco rods separated by a gap, a rod-insertion component to insert a rod article in the gap, and a wrapping station to apply a wrapper around an inserted rod article.]

[36. The modular apparatus in claim 32, comprising a drum-receiving portion adapted to selectively receive a first drum and a second drum.]

[37. The modular apparatus in claim 36, comprising a suction control element configured to apply suction to either the first or the second drum.]

[38. The modular apparatus in claim 37, comprising four drums.]

[39. A kit of parts to assemble a modular apparatus as claimed in claim 1.]

40. A modular apparatus for smoking article assembly, comprising:

a plurality of modules, each comprising a plurality of functional units, each of said plurality of modules comprising a single respective interface unit, and

a controller configured to control each of said plurality of functional units on each of said plurality of modules via said interface units, wherein the interface unit of each module is configured to mediate communication between the controller and said plurality of functional units on the module,

wherein the modular apparatus is configured to cause received rods of smokeable material to undergo a first sequence of operations and

wherein each said module comprises one or more drums and the controller controls said one or more drums of each said module via the interface unit of its module, and

wherein the modular apparatus can be reconfigured by: replacing at least one of said drums of at least one of said plurality of modules, and

one or more of: repositioning modules relative to one another; removing one or more of the modules; or adding one or more further modules,

so as to cause received rods of smokeable material to undergo a second sequence of operations, different to the first sequence of operations,

wherein the first and second sequences of operations respectively form at least part of first and second processes for assembling smoking articles, each smoking article comprising a said rod of smokeable material, which is smoked in use.

41. The modular apparatus for smoking article assembly as claimed in claim 40, wherein each said drum has a respective drive mechanism to drive the drum, wherein each of said drive mechanisms is controlled by the controller via the interface unit of its module.

42. The modular apparatus as claimed in claim 41, wherein each of said drive mechanisms comprises an integrated servo drive.

43. The modular apparatus as claimed in claim 40, wherein the modules receive electrical power from the controller via the interface units.

44. The modular apparatus according to claim 40, further comprising:

a first inserter configured to insert a first rod article between two tobacco rods;

a first rod divider configured to divide the first rod article into at least two parts,

a separator configured to separate a first group comprising a rod of smokeable material and one of said parts from a second group comprising a rod of smokeable material and another of said parts, and

a second inserter configured to insert a second rod article between the first and second groups.

45. The modular apparatus as claimed in claim 44, further comprising:

a second rod divider configured to divide the second rod article into at least two parts; and

a wrapping station configured to wrap a wrapper at least partially around an inserted rod article after the inserted rod article is inserted between the two tobacco rods and before the inserted rod article is divided by a rod divider.

46. The modular apparatus as claimed in claim 44, wherein the modular apparatus comprises a first module comprising said first inserter, and a second module comprising said second inserter.

47. The modular apparatus as claimed in claim 40, comprising:

a plurality of inserters, each said inserter being configured to insert a rod article between two tobacco rods;

a plurality of rod dividers, each said rod divider being configured to divide a rod article into at least two parts, and

a plurality of wrapping stations, each said wrapping station being configured to wrap a wrapper at least partially around an inserted rod article after the rod article is inserted between two tobacco rods and before the inserted rod article is divided by a rod divider.

48. The modular apparatus as claimed in claim 40, wherein the modular apparatus includes a plurality of modules of different types having different functions.

49. The modular apparatus as claimed in claim 40, wherein the modular apparatus includes two or more modules, each having a separate base unit and one or more drums, wherein each of said two or more modules is configured to receive the same number of drums.

50. The modular apparatus as claimed in claim 49, wherein each of said two or more modules are configured to receive drums in corresponding positions with respect to the respective base unit.

51. The modular apparatus as claimed in claim 40, wherein said first process for assembling smoking articles forms a first configuration of smoking article and wherein said second process for assembling smoking articles forms a second configuration of smoking article different to the first configuration.

52. The modular apparatus as claimed in claim 40, wherein said first and second sequences of operations cause rods of smokeable material to be respectively combined with one or more rod articles.

53. The modular apparatus as claimed in claim 40, comprising a plurality of modules configured to receive said rods of smokeable material, said plurality of modules comprising a plurality of functional units configured to cause said rods of smokeable material to undergo said first sequence of operations.

54. The modular apparatus as claimed in claim 53, wherein said functional units comprise a plurality of conveying elements arranged to define a conveyance path through the modular apparatus, along which rods of smokeable material are caused to undergo said first sequence of operations.

55. The modular apparatus as claimed in claim 40, wherein said plurality of modules comprise a reconfigurable module, wherein reconfiguration of the modular apparatus comprises reconfiguring said reconfigurable module.

56. The modular apparatus as claimed in claim 40, wherein when reconfigured, the modular apparatus comprises a plurality of modules, said plurality of modules comprising a plurality of functional units configured to cause rods of smokeable material to undergo said second sequence of operations.

57. The modular apparatus as claimed in claim 40, wherein modules are arranged in a row to cause said rods of smokeable material to undergo said first and second sequences of operations.

58. The modular apparatus as claimed in claim 40, wherein at least one module is left unchanged when the modular apparatus is reconfigured for said second sequence of operations.

59. The modular apparatus as claimed in claim 58, wherein said at least one-module which is left unchanged comprises an in-feed module configured to receive rods of smokeable material.

60. The modular apparatus as claimed in claim 40, wherein each module comprises one or more servo motors and wherein said servo motors are synchronized.

61. The modular apparatus as claimed in claim 40, wherein the modular apparatus comprises a first group-forming apparatus configured to associate a rod of smokeable material with a rod article to form a first group, and a second group-forming apparatus configured to associate a rod article with the first group to form a second group.

62. The modular apparatus as claimed in claim 61, wherein the modular apparatus comprises a first module comprising said first group-forming apparatus and a second module comprising said second group-forming apparatus.

63. The modular apparatus as claimed in claim 40, comprising a first wrapping station to apply a first wrapper to the smoking article and a second wrapping station to apply a second wrapper to the smoking article after the first wrapper is applied.

64. The modular apparatus as claimed in claim 63, wherein the second wrapping station is configured to apply the second wrapper so that it overlaps with the first wrapper.

65. The modular apparatus as claimed in claim 63, wherein the second wrapping station is configured to apply to the second wrapper so that there is a longitudinal gap between the first wrapper and the second wrapper.

66. The modular apparatus as claimed in claim 63, wherein the first wrapping station is included in a first module and the second wrapping station is included in a second module.

67. A method of reconfiguring a modular apparatus as claimed in claim 40, comprising repositioning modules relative to one another and/or removing on or more modules and/or adding one or more further modules and/or reconfiguring one or more of the modules.

68. A method as claimed in claim 67, comprising repositioning modules relative to one another.

69. A module of a modular apparatus as claimed in claim 43, the module having an interface unit configured so that the module can be controlled by the controller.

70. The module of claim 69, wherein the module is a reconfigurable module comprising a base unit configured to removably receive a plurality of different parts.

71. The module of claim 70, wherein in a first configuration of the reconfigurable module, the base unit is fitted with a rod-receiving component to receive a group of rod articles, a rod-cutting component to cut a central rod in said group of received articles into two segments, and a rod-separating component to separate the segments, thereby to form two spaced rod groups.

72. The module as claimed in claim 71, wherein in a second configuration of the reconfigurable module, the base unit is fitted with a rod-receiving component to receive two tobacco rods which are longitudinally separated by a gap, a rod-insertion component to insert a rod article in the gap, a rod-cutting component to cut an inserted rod article into two segments, and a rod separating component to separate the segments, thereby to form two spaced rod groups.

73. The module as claimed in claim 72, wherein in a third configuration of the reconfigurable module, the base unit is fitted with a rod-receiving component to receive two tobacco rods separated by a gap, a rod-insertion component to insert a rod article in the gap, and a wrapping station to apply a wrapper around an inserted rod article.

74. The module as claimed in claim 70, comprising a drum-receiving portion adapted to selectively receive first and second drums.

75. The module as claimed in claim 74, comprising a suction control element configured to apply suction to either the first or the second drum.

76. The module as claimed in claim 75, comprising four drums.

77. A smoking article assembling apparatus comprising a modular apparatus as claimed in claim 40.

78. The smoking article assembling apparatus as claimed in claim 70, further comprising a tobacco rod source, wherein the modular apparatus is arranged to receive tobacco rods from the tobacco rod source.

79. The smoking article assembling apparatus as claimed in claim 71, wherein the modular apparatus is arranged to receive tobacco rods directly from the tobacco rod source.

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