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(54) **A SMOKING ARTICLE ASSEMBLY MACHINE**

(71) Applicant: **British American Tobacco (Investments) Limited**, London (GB)

(72) Inventors: **Gary FALLON**, London (GB); **William England**, London (GB); **Kie Seon PARK**, London (GB)

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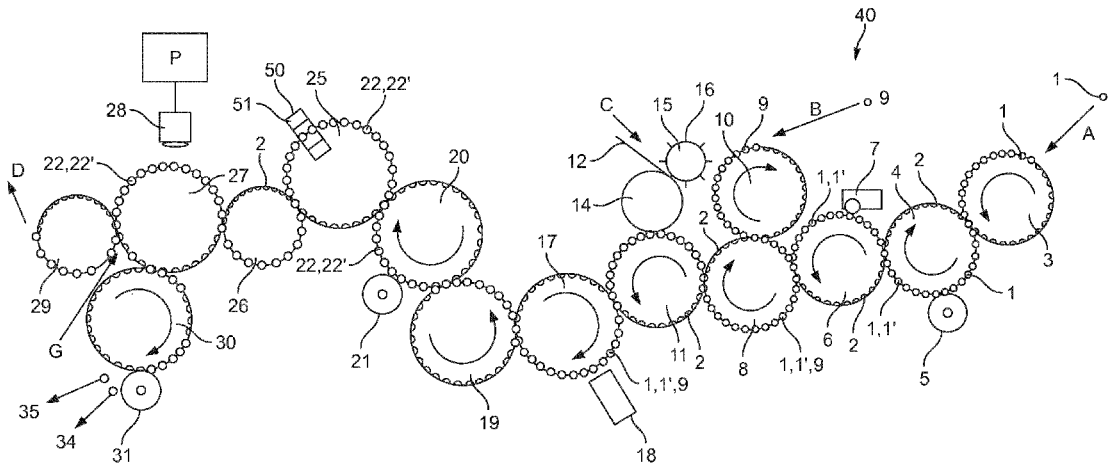
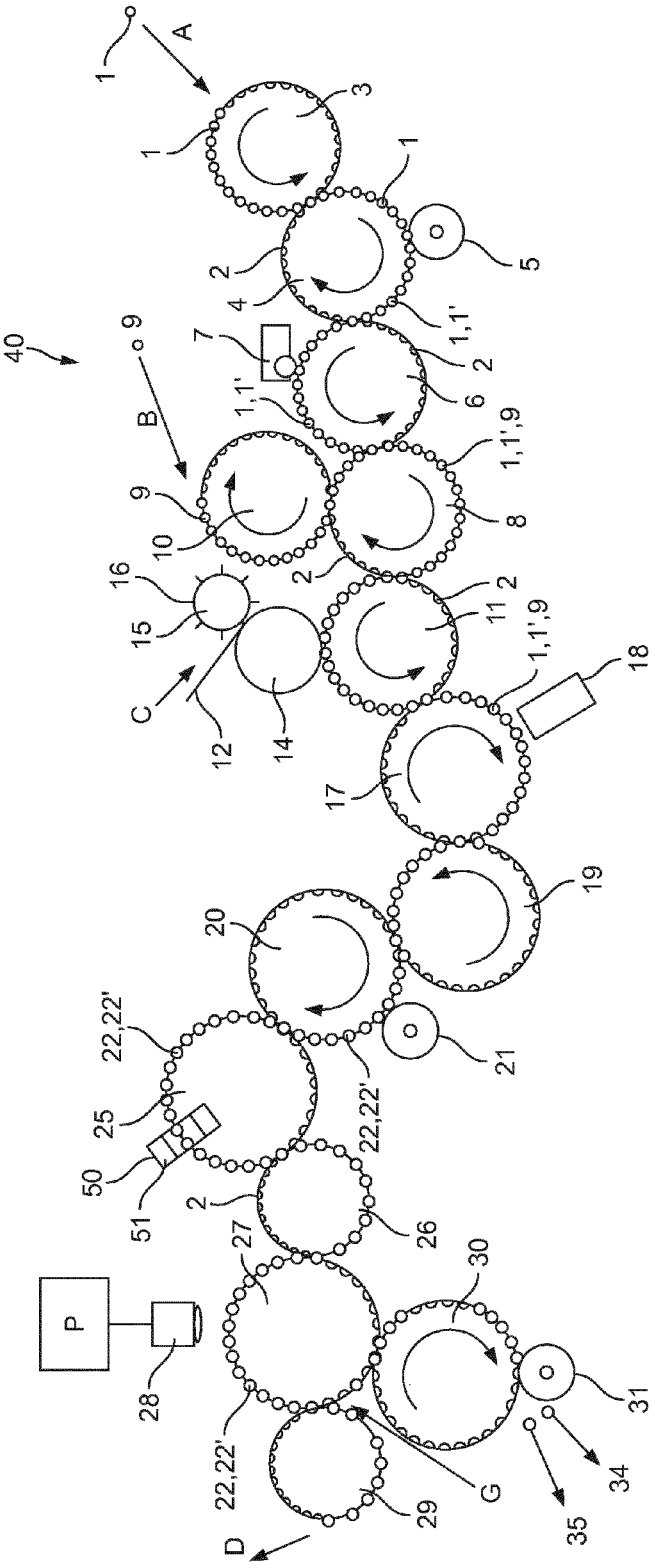
(57) **ABSTRACT**

The present application relates to a smoking article assembly machine. The smoking article assembly machine has a filter rod receiving section configured to receive filter rods (**9**) containing an inserted object (**36**, **36'**) and an assembled smoking article discharge section. The smoking article assembly machine also has a smoking article assembly path between the filter rod receiving section and the assembled smoking article discharge section along which filter rods (**9**) pass in a transverse direction to the longitudinal axis of filter rods, and a microwave sensor unit (**51**) through which filter rods (**9**) pass in a transverse direction, the microwave sensor unit (**51**) being disposed along the assembly path. The microwave sensor unit (**51**) is configured to provide an indication of one or more properties of an inserted object (**36**, **36'**) in each filter rod (**9**) passing transversely along the smoking article assembly path. The present application also relates to a method of assembling a smoking article on a smoking article assembly machine.




40
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G
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22,22'
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50
51
1,1'
1,1',9

FIG. 1

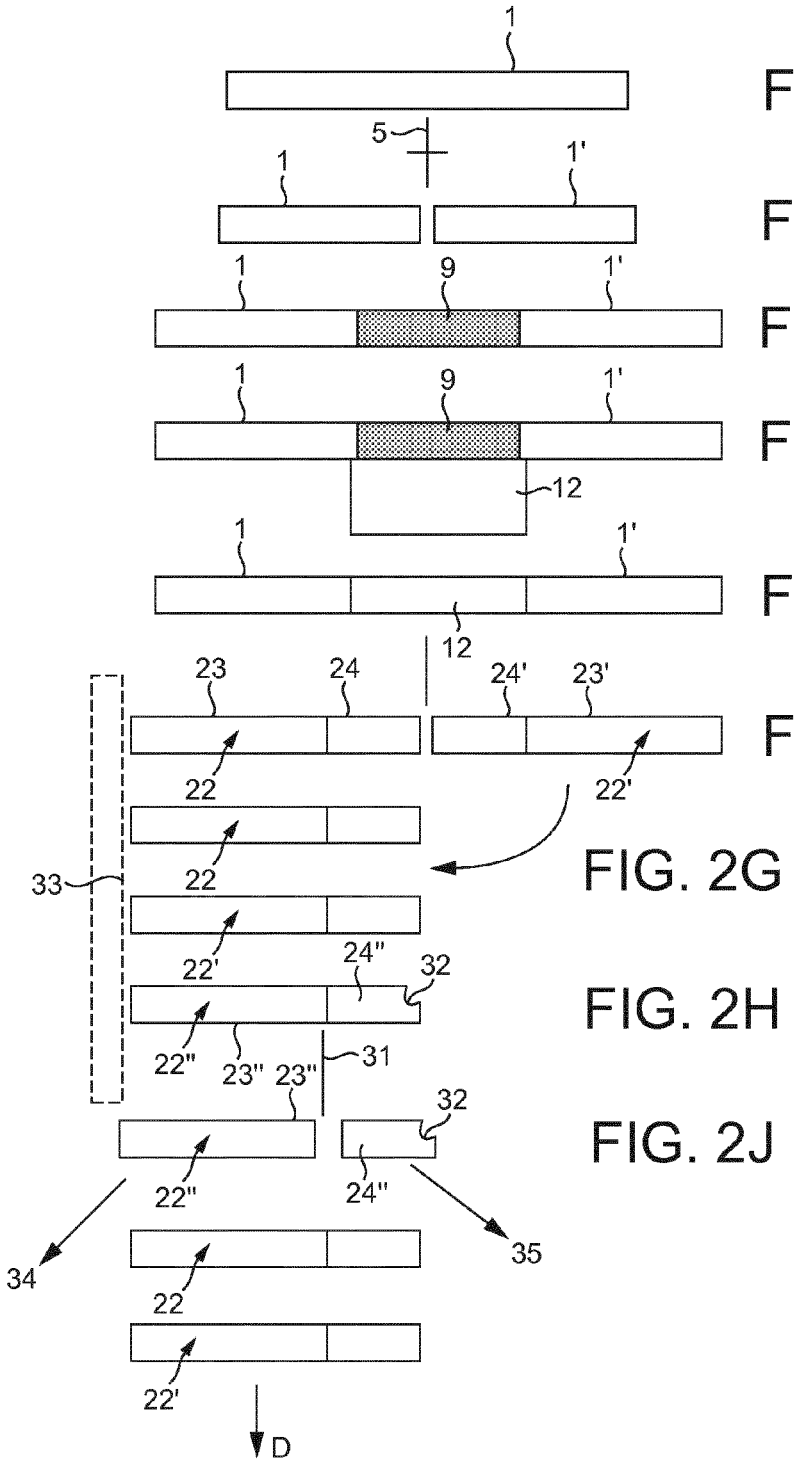


FIG. 2A

FIG. 2B

FIG. 2C

FIG. 2D

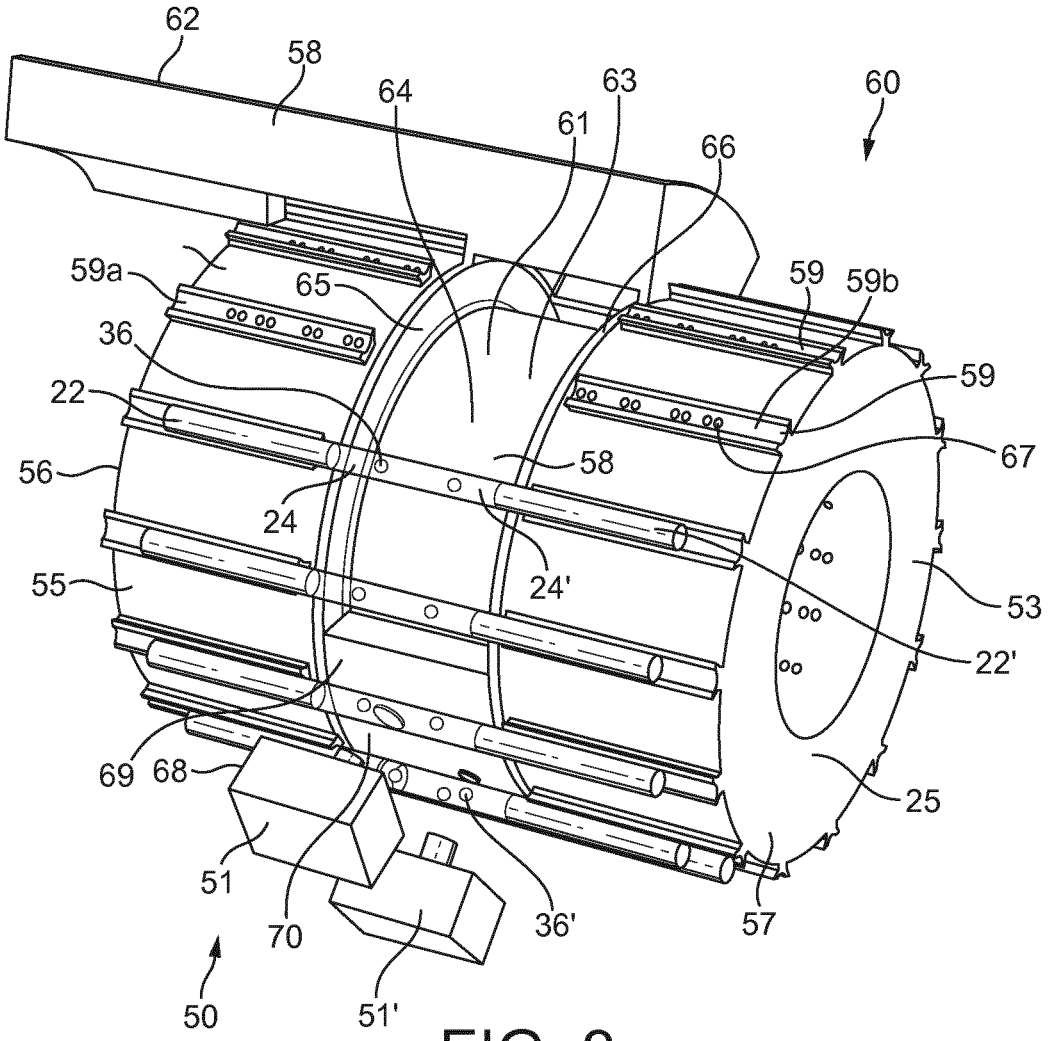
FIG. 2E

FIG. 2F

FIG. 2G

FIG. 2H

FIG. 2J


62
58
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59a
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59b
36
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22
67
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24
24'
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70
36'
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50
51'

FIG. 3

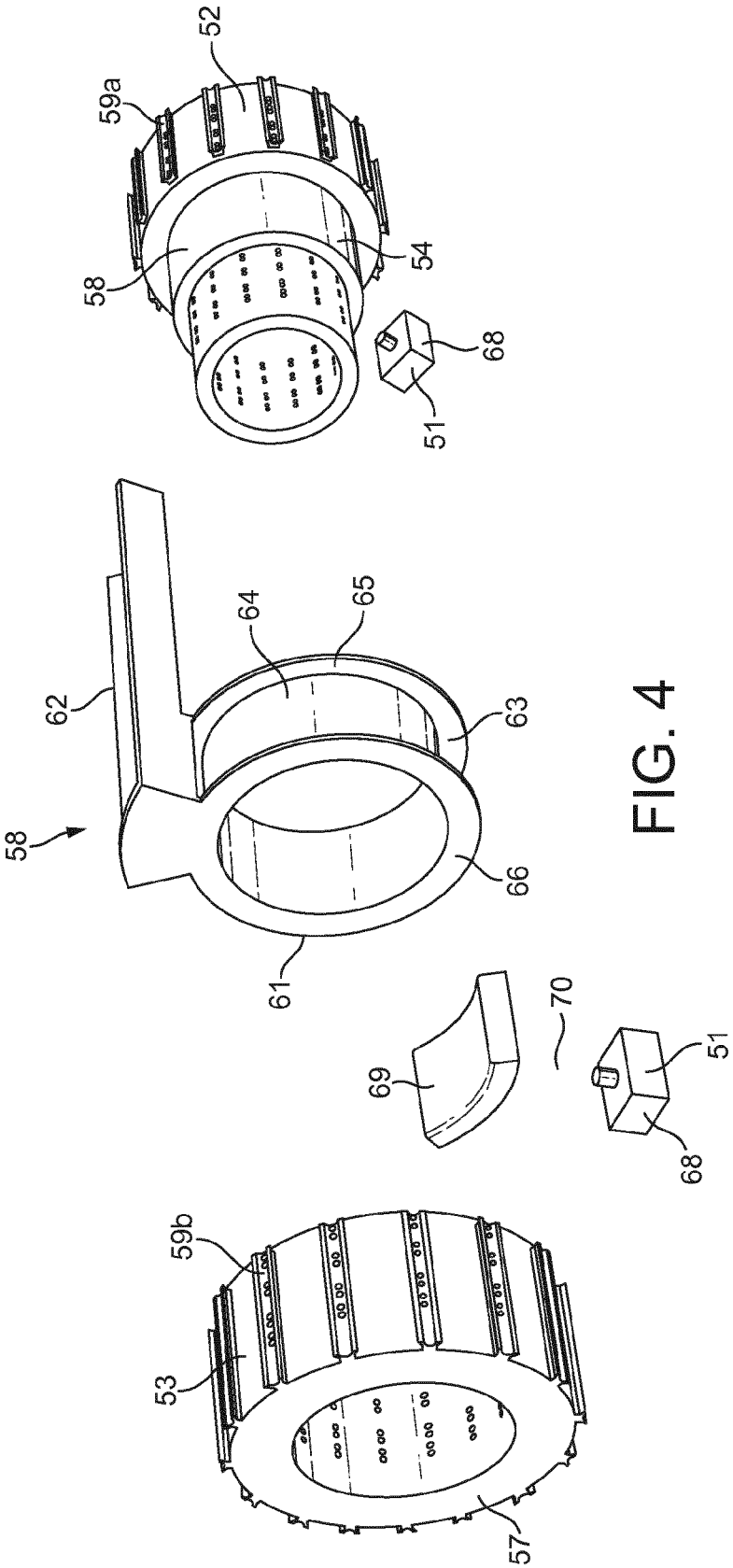


FIG. 4

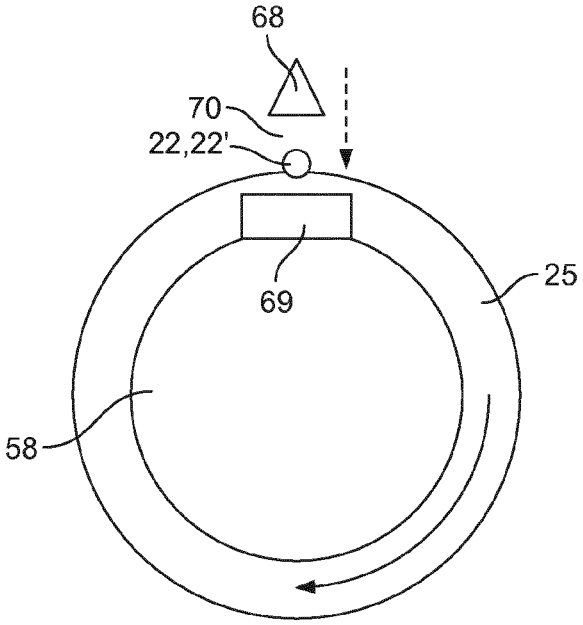


FIG. 5

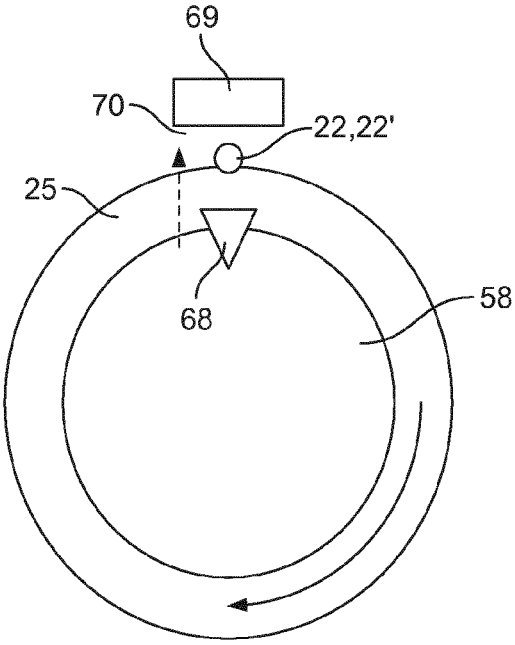


FIG. 6

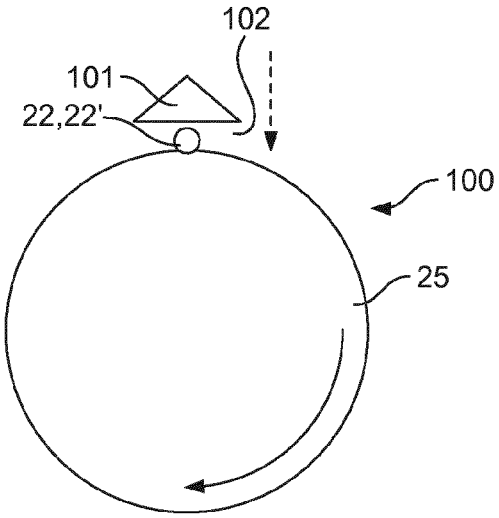
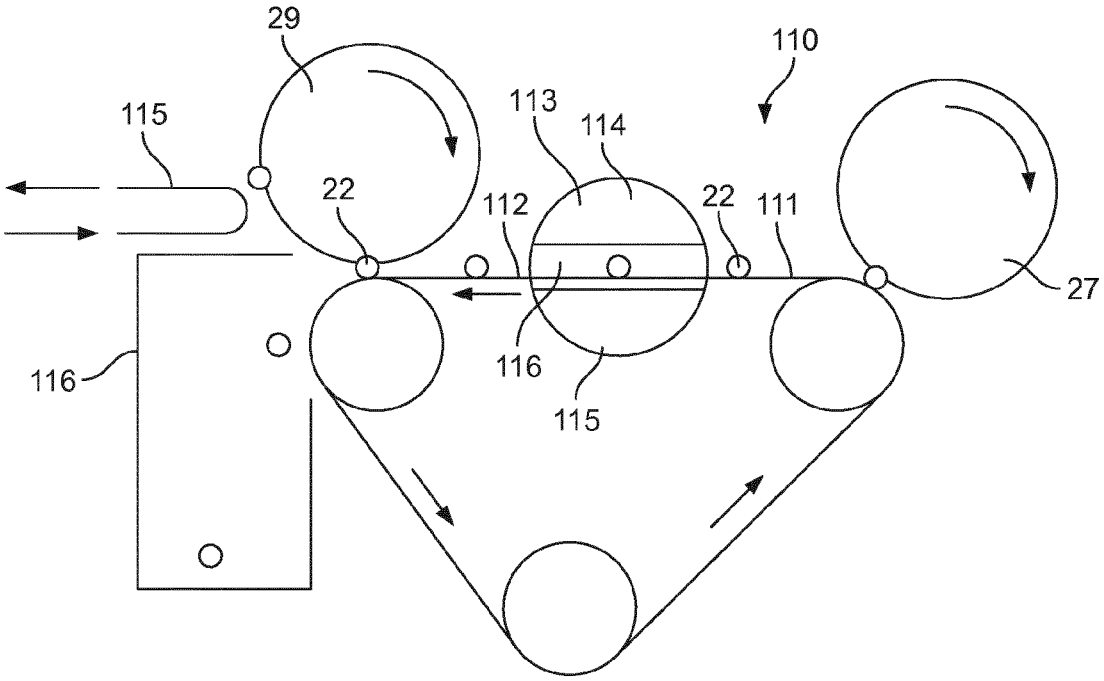

102
101
22,22'
100
25

FIG. 7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110
115
113
114
22
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22
111
27
116
116
115

FIG. 8

A SMOKING ARTICLE ASSEMBLY MACHINE

TECHNICAL FIELD

[0001] The present invention relates to a smoking article assembly machine. The present invention also relates to a method of assembling a smoking article on a smoking article assembly machine.

BACKGROUND

[0002] Smoking articles are known in which a capsule is disposed. Such a capsule generally contains a fluid, such as a flavourant. The capsule may be frangible such that the frangible capsule is broken, and the fluid released, when a user applies pressure to the filter rod in the proximity of a frangible capsule.

[0003] Such a smoking article is manufactured by manufacturing filter rods containing capsules on a filter making machine and tobacco rods on a tobacco rod making machine. The manufactured filter rods and tobacco rods may then be used in the assembly of smoking articles on a smoking article assembly machine. An example of such a smoking article assembly machine is the Hauni Max manufactured by Hauni Maschinenbau AG of Hamburg Germany.

SUMMARY

[0004] According to one aspect of the invention, there is provided a smoking article assembly machine comprising a filter rod receiving section configured to receive filter rods containing an inserted object, an assembled smoking article discharge section, a smoking article assembly path between the filter rod receiving section and the assembled smoking article discharge section along which filter rods pass in a transverse direction to the longitudinal axis of filter rods, and a microwave sensor unit through which filter rods pass in a transverse direction, the microwave sensor unit being disposed along the assembly path configured to provide an indication of one or more properties of an inserted object in each filter rod passing transversely along the smoking article assembly path through the microwave sensor unit.

[0005] The microwave sensor unit may comprise stationary first and second detector units between which filter rods pass in a transverse direction.

[0006] The smoking article assembly machine may further comprise a conveyor drum arrangement including a rotatable drum configured to receive said filter rods, or at least partially assembled smoking articles including said filter rods, around its periphery and thereby to transport said filter rods along an arced path during its rotation, the microwave sensor unit being configured to provide an indication of one or more properties of an inserted object in each filter rod received by the rotatable drum.

[0007] The microwave sensor unit may comprise a first detector unit and a second detector unit configured to provide an indication of one or more properties of an inserted object in each filter rod when each filter rod is interposed between the first detector unit and the second detector unit.

[0008] The first detector unit may be outside the diameter of the arced path of said filter rods. The second detector unit may be within the diameter of the arced path of said filter rods.

[0009] The first detector unit may be within the diameter of the arced path of said filter rods. The second detector unit may be outside the diameter of the arced path of said filter rods.

[0010] The rotatable drum may be configured to move relative to the microwave sensor unit. The first detector unit may be a microwave transmitter and the second detector unit may be a microwave receiver.

[0011] The first detector unit may be a microwave receiver and the second detector unit may be a microwave transmitter.

[0012] The microwave sensor unit may comprise a planar resonator on the smoking article assembly path.

[0013] The smoking article assembly machine may further comprise a base about which the rotatable drum is rotatable. At least one of the first and second detector units may be on the base.

[0014] The base may extend around the rotatable drum.

[0015] The rotatable drum may further comprise a first drum section and a second drum section extending on either side of the base.

[0016] The rotatable drum may be an intermediate drum.

[0017] The smoking article assembly machine may further comprise a linear conveyor arrangement configured to receive said filter rods, or at least partially assembled smoking articles including said filter rods, and thereby to transport said filter rods along a linear path, the microwave sensor unit being configured to provide an indication of one or more properties of an inserted object in each filter rod received by the linear conveyor arrangement.

[0018] The microwave sensor unit may comprise a fork resonator on the smoking article assembly path.

[0019] The smoking article assembly machine may comprise at least two microwave sensor units configured to provide an indication of one or more properties of an inserted object in each filter rod at two or more points along or adjacent to the path of each filter rod.

[0020] The microwave sensor unit may comprise at least two first and/or two second detector units configured to provide an indication of one or more properties of an inserted object in each filter rod at two or more points along or adjacent to the path of each filter rod.

[0021] The microwave sensor may comprise at least two first detector units and at least two corresponding second detector units. The microwave sensor unit may comprise at least two first detector units and one corresponding second detector unit. The microwave sensor unit may comprise one first detector unit and at least two corresponding second detector units.

[0022] The filter rod receiving section configured to receive filter rods containing an inserted object may be a filter rod receiving section configured to receive filter rods containing a capsule.

[0023] The microwave sensor unit may be configured to be stationary during operation.

[0024] According to another aspect of the invention, there is provided a method of assembling a smoking article on a smoking article assembly machine comprising receiving a filter rod containing an inserted object, assembling the smoking articles including the filter rod containing the inserted object, and discharging the assembled smoking article, the method further including passing filter rods in a transverse direction to the longitudinal axis of the filter rod through a microwave sensor unit to provide an indication of

one or more properties of the inserted object in the filter rod between receiving the filter rod and discharging the assembled smoking article.

BRIEF DESCRIPTION OF DRAWINGS

[0025] Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

[0026] FIG. **1** is a schematic side view of a cigarette making machine;

[0027] FIGS. **2**A to **2**J illustrate successive stages during the manufacture of filter cigarettes with the machine shown in FIG. **1**;

[0028] FIG. **3** is a view of an intermediate drum of the cigarette making machine shown in FIG. **1** showing one embodiment of a microwave detector station;

[0029] FIG. **4** is an exploded view of the intermediate drum shown in FIG. **3** with the microwave detector station;

[0030] FIG. **5** is a schematic view of the intermediate drum shown in FIG. **3** with the microwave detector station;

[0031] FIG. **6** is a schematic view of the intermediate drum shown in FIG. **3** with another embodiment of a microwave detector station;

[0032] FIG. **7** is a schematic view of the intermediate drum shown in FIG. **3** with another embodiment of a microwave detector station; and

[0033] FIG. **8** is a schematic view of a discharge section of the cigarette making machine shown in FIG. **1** with another embodiment of a microwave detector station.

DETAILED DESCRIPTION

[0034] Referring to FIG. **1**, a cigarette making machine is illustrated. The cigarette making machine acts as a smoking article making machine. Although the following description describes a cigarette making machine, it will be understood that alternative arrangements are possible in which the smoking article making machine makes other types of smoking article. Any reference to a cigarette can be replaced by a reference to a smoking article.

[0035] As used herein, the term "smoking article" includes smokeable 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.

[0036] In FIG. **1** a cigarette making machine is illustrated in which smoking articles in the form of filter cigarettes are manufactured in a series of fabrication steps performed at fabrication stations along a production line. The fabrication steps include attaching rods of tobacco to opposite ends of a filter rod, cutting the filter rod to produce two cigarettes back-to-back, re-aligning the cigarettes carrying out a quality control inspection, rejecting unacceptable cigarettes and passing accepted cigarettes for packaging.

[0037] The cigarette making machine defines a smoking article assembly path between a filter rod receiving section and an assembled smoking article discharge section. The cigarette making machine comprises a conveyer drum arrangement **40**. The conveyer drum arrangement **40** transports the tobacco rods and filter rods along the smoking article assembly path. The conveyer drum arrangement **40** also enables assembly of the cigarettes along the smoking article assembly path. The conveyer drum arrangement comprises a plurality of rotatable drums, also known as rollers, which are configured to transport filter rods or at least partially assembled cigarettes along the smoking article assembly path. As the filter rods or at least partially assembled cigarettes are transported along the smoking article assembly path by each of the rotatable drums, it will be understood that they travel in a direction transverse to their longitudinal axis. That is, the filter rods or at least partially assembled cigarettes move in a direction which is perpendicular or substantially perpendicular to their longitudinal axis.

[0038] As shown in FIG. **1**, successive lengths of tobacco rod **1** manufactured by a rod making machine are fed from a hopper to an inlet drum **3** by means of a spider (not shown), such that they are received in axially extending grooves **2** on the surface of the inlet drum **3** of the conveyer drum arrangement **40**. The tobacco rods **1** are held in the grooves **2** by negative air pressure. As illustrated in FIG. **2**A, each of the tobacco rods **1** has a length corresponding to two cigarettes. The tobacco rods **1** may comprise tobacco or like smokeable material wrapped in a paper wrapper.

[0039] The conveyer drum arrangement **40** conveys the tobacco rods **1** from the tobacco rod receiving section. That is, the point at which they are received from the hopper to a point at which the inlet drum **3** of the conveyer drum arrangement **40** meets a cutter drum **4**. At this point, the rods **1** on conveyer drum arrangement **40** are fed into corresponding grooves **2** of the cutter drum **4**, where they pass a rotary cutter blade **5** that cuts the rods **1** in half as illustrated in FIG. **2**B to form cut rods **1**, **1'**. The cut rods **1**, **1'** then pass onto grooves **2** of a spacer drum **6** which is driven in synchronism with the cutter drum **4**. A spacer device **7** separates the cut rods **1**, **1'** and passes them onto a filter receiving drum **8** that also has grooves **2**. The various rods can be held in the grooves **2** of the conveyer drums **4**, **6**, **8**, **10**, **11**, **17**, **19**, **20**, **25**, **26**, **27**, **29**, **30** of the cigarette making machine described herein by negative air pressure.

[0040] The cut rods **1**, **1'** are spaced apart by a distance sufficient to receive a length of filter rod **9**. Successive lengths of filter rod **9** are manufactured by a filter rod making machine (not shown). The filter rod making machine produces continuous lengths of filter rod which are subsequently cut prior to being received by a filter rod hopper (not shown). The filter rod making machine and cigarette making machine are independent of each other. That is, the lengths of filter rod are taken off-line following manufacture on the filter rod making machine, and are subsequently fed to the cigarette making machine. The filter rods may comprise cellulose acetate tow wrapped in a plug wrap or may include other or additional filter material. The lengths of filter rod **9** for use in the present invention each include at least two inserted objects **36**, **36'** (refer to FIG. **3**), such as frangible capsules. Each capsule may hold a fluid, such as a flavourant, which is released when the frangible capsule is broken by a user applying pressure to the filter rod in the proximity of the frangible capsule. The filter rods **9** may include additional material, such as a Dalmatian filter segment or adsorbent such as particles of activated carbon. It will be understood that it is necessary to check whether the inserted objects are present, and/or, in the case of a frangible capsule for example, intact, following manufacture of the continuous lengths of filter rod. Such detection of the state or presence of an inserted object has previously been performed offline

on a separate machine following manufacture of the continuous lengths of filter rod **9**, and prior to providing the continuous lengths of filter rod to the cigarette making machine.

[0041] Following manufacture of the continuous lengths of filter rod on the filter rod making machine and prior to the continuous lengths of filter rod being received by the cigarette making machine, the lengths of filter rods may be stored. The cut lengths of filter rod **9** are received by the filter rod hopper (not shown) of the cigarette making machine.

[0042] The cut lengths of filter rod **9** are fed onto the filter receiving drum **8** from filter inlet drum **10** that receives successive filter rods **9** from a hopper (not shown) fed in the direction of arrow B. Although in the present arrangement a single filter receiving drum **8** is described and shown, it will be understood that further drums may be disposed between the filter rod hopper (not shown) and the filter inlet drum **10**, such as a filter rod cutting drum, a grading drum, a shifting drum and an accelerating drum. Where the filter rods **9** enter the cigarette making machine is the filter rod receiving section.

[0043] The resulting configuration of tobacco rods **1**, **1'** and filter rod **9** on the filter receiving drum **8** is illustrated in FIG. **2**C. This arrangement of aligned rods is then transferred to a tipping drum **11** that is driven in synchronism with filter receiving drum **8** and a washplate (not shown) to ensure that the rods **1**, **9** and **1'** abut one another.

[0044] Then, a cut length of tipping paper **12** is applied to the filter rod **9** so as to overlap its ends and join the rods **1**, **1'**, **9** together as illustrated in FIG. **2**D. The tipping paper **12** is fed as a web from a supply roll (not shown) in the direction of arrow C onto an applicator roller **14** after having been passed over a curling plate and having adhesive applied in a manner well known per se and not illustrated in FIG. **1** in order to simplify the explanation. A cutter roller **15** with blades **16** cuts the continuous web of tipping paper into individual segments of tipping paper **12** for each pair of cigarettes as illustrated in FIG. **2**D. The action of the drum **11** is to roll the tipping paper around the coaxial arrangement of rods **1**, **1'**, **9** shown in FIG. **2**D so that they become joined by the glued tipping paper segment **12** to provide the combined rod arrangement illustrated in FIG. **2**E.

[0045] The combined rod arrangement **1**, **1'**, **9** is then transferred to a ventilation forming station that comprises a synchronously driven drum **17** with an associated laser **18** which burns ventilation holes into the filter and/or tobacco rods **1**, **9**, **1'**. The ventilated rods are then passed by a feeder roller **19** to a cutting station comprising a final cut roller **20** and rotary cutter blade **21** which cuts the joined rods in half by the rotary cutter blade **21** to provide a pair of cigarettes **22**, **22'** with tobacco rods **23**, **23'** and filter rod segments **24**, **24'** respectively arranged back-to back, as shown in FIG. **2**F.

[0046] The cut cigarettes **22**, **22'** are then fed onto the periphery of an intermediate drum **25** shown in FIG. **1**. The intermediate drum **25** is disposed on the smoking article assembly path between the final cut roller **20** and the turning drum **26**. The intermediate drum **25** is driven in synchronism with final cut roller **20**. The intermediate drum **25** transports the cigarettes **22**, **22'**. A microwave detector station **50** comprising the intermediate drum **25** is provided to inspect the properties of an inserted object **36**, **36'** in each filter rod segment **24**, **24'**. The microwave detector station **50** comprises two microwave sensor units **51** (only one shown in FIG. **1**). The microwave sensor units **51** are offset from one another. The two microwave sensor units **51** are aligned with the path of the pair of cigarettes **22**, **22'** to provide an indication of one or more properties of an inserted object **36**, **36'** in each filter rod segment **24**, **24'**, passing transversely along the smoking article assembly path. One advantage of offsetting the microwave sensor units **51** is to allow the microwave sensor units **51** to be received with a space having a limited width in the axial direction, and to restrict any interference between adjacent microwave sensor units **51**. However, it will be understood that in an alternative embodiment that the microwave sensor units **51** are axially aligned with each other.

[0047] Although two microwave sensor units **51** are described in the present embodiment, it will be understood that in an alternative embodiment only one microwave sensor unit **51** may be present. For example, in an arrangement in which the microwave detector station **50** is disposed further down the smoking article assembly path, as will be described hereinafter, only a single microwave sensor unit may be present as the cigarettes **22'** are aligned with the cigarettes **22**.

[0048] A detailed description of the microwave detector station **50** will be given below.

[0049] The cut cigarettes **22**, **22'** are then fed onto the periphery of a turning drum **26** shown in FIG. **1** that is driven in synchronism with intermediate drum **25** at which the cigarettes **22'** are flipped over to be aligned with cigarettes **22** as illustrated in FIG. **2**G.

[0050] The aligned cigarettes **22**, **22'** are then fed from the turning drum **26** into grooves **2** of inspection drum **27** that rotates in synchronism with turning drum **26**. Therefore, the aligned cigarettes are fed successively through an inspection station comprising the inspection drum **27** at which a camera **28** or other optical detector carries out an inspection of the quality of the thus manufactured cigarettes received in grooves **2** of the inspection drum **27**. The camera **28** feeds data to a processor P which compares it with stored information corresponding to quality control criteria so as to control a diverter gate G depending on the outcome, so that the cigarettes which meet the quality control criteria are fed in an accept path onto outlet drum **29** driven in synchronism with inspection drum **27** and then pass in the direction of arrow D onto an output conveyor (not shown) for packaging. The diverter gate G diverts rejected cigarettes so that they continue on a reject path around the inspection drum **27** and transfer onto a reject drum **30**. The diverting action of the gate G may be implemented or assisted by controlling or releasing a negative pressure that retains the cigarettes **22** in the grooves **2** on the inspection drum **27**.

[0051] The processor P may also or alternatively receive quality control data from other tests performed on the cigarettes whilst they pass along the smoking article assembly path, which can used to control the diverter gate G. For example, the cigarettes may be subject to a pressure test as they pass around the inspection drum **27**, in which air is pumped into one end and the pressure drop through the rod is measured. If the pressure drop is too high or too low, this indicates a bad join between the tobacco rod and filter of the cigarettes **22**, **22'** such that the cigarette should be rejected. Also an optical detector (not shown) may be provided to detect loose ends where not enough tobacco fills the rod, or strands of tobacco that are protruding from the rod ends.

[0052] The processor P may also or alternatively receive data on the properties of an inserted object **36**, **36'** in each filter rod segment **24**, **24'** determined as they pass through the microwave detector station **50**. This data may be used to control the diverter gate G. For example, the microwave detector station **50** may be used to measure the moisture level. If the determined moisture level is too high or too low, this may indicate a damaged capsule in the filter rod segment **24**, **24'** such that the cigarette should be rejected. Alternatively, a different control means and/or discharge means may be used together with the microwave detector station **50**.

[0053] Referring to FIG. **2**H, it can be seen that rejected cigarette **22"** has a filter **24"** that includes a fault **32** at its mouth end which will be unacceptable to the user. The rejected cigarettes that pass cutter **31** abut against a transverse guide **33** and so are accurately aligned axially. As a result, the cutter blade **31** can accurately cut the filter **24"** from the tobacco rod **23"** as shown in FIG. **2**J through the tobacco rod whilst in situ on the reject drum **30**. The cut filter **24"** falls along a first reject path **34** whereas the tobacco rod **23"** falls along a second reject path **35** as shown in FIG. **2**J.

[0054] Many modifications and variations to the described cigarette making machine will be evident to those skilled in the art. For example the described process may be used for smoking articles other than cigarettes.

[0055] Also, further quality control measures may be included. For example, the combination of rods shown in FIG. **2**C may be rejected either after optical detection or in terms of their combined weight e.g. at drum **8**, so as to detect whether a filter rod **9** was successfully placed between the tobacco rods **1**, **1'**.

[0056] It will also be appreciated that the various steps of production described with reference to FIG. **2** can be altered and modified. For example additional conveyer drums may be included along the smoking article assembly path to allow additional manufacturing steps to be performed, and/or particular conveyer drums may be reordered or omitted.

[0057] With reference to FIGS. **3** to **5**, one embodiment of the microwave detector station **50** is shown. In the present embodiment, the microwave detector station **50** is arranged to analyze the condition of filter rod segments **24**, **24'** at the intermediate drum **25** of the smoking article machine. An advantage of providing the microwave detector station **50** at the position of the intermediate drum **25** is that it is proximate to the end of the smoking article assembly path, and also prior to the inspection drum **27**. Therefore, it is possible to detect any damage caused to the objects **36**, **36'** inserted in the filter rod segments during assembly of the smoking articles **22**, **22'**. Furthermore, it is possible to utilize the inspection station to discard any smoking articles having faulty filter rod sections **22**, **22'** determined by the microwave detector station **50**. However, it will be understood that the microwave detector station **50** may be disposed at a different location within the smoking article machine.

[0058] An intermediate drum arrangement **60** includes the intermediate drum **25** and a stationary collar **61**. The drum sections **52**, **53** are configured to rotate about the stationary collar **61**. The microwave detector station **50** includes the intermediate drum arrangement **60** and first and second microwave sensor units **51**, **51'**. It will be understood that the microwave detector station **50** may alternatively include another conveyer drum instead of the intermediate drum **25**.

[0059] The intermediate drum **25** forms a hollow cylinder. The intermediate drum **25** comprises a first drum section **52** and a second drum section **53**. The first and second drum sections **52**, **53** are fixedly mounted to each other by a hollow shaft **54**. The first and second drum sections **52**, **53** are configured to rotate in synchronization. The first and second drum sections **52**, **53** may be integrally formed.

[0060] The intermediate drum **25** has a cylindrical wall **55**, end walls **56**, **57**, and a circumferentially extending channel **58**. The channel **58** is configured to receive the stationary collar **61**. The stationary collar **61** is configured to be slidably mounted in the channel **58** of the intermediate drum **25** so that the intermediate drum **25** is rotatable thereabout. Moreover, the drum is configured to be rotatable about its cylindrical axis. The channel **58** is formed between the first and second drum sections **52**, **53**.

[0061] The stationary collar **61** is recessed below the outer surface of the cylindrical wall **55**. That is, the outer diameter of the stationary collar **61** is less than the diameter of the outer surface of the cylindrical wall **55**. Therefore, the stationary collar **61** does not interact with combined rod arrangement **1**, **1'**, **9** as it moves along its path. A support **62** extends from the collar **61** away from the path of the combined rod arrangement **1**, **1'**, **9**. A recess **63** is formed in the collar **61**. The recess **63** is formed by a base **64** and side walls **65**, **66** of the stationary collar **61**. The recess **63** is formed in the outer side of the stationary collar **61**.

[0062] The intermediate drum **25** has axially extending grooves **59**, as already described with reference to FIG. **1**. The grooves **59** act as smoking article conveying points. The intermediate drum **25** also has a pump (not shown) and pressure delivery apparatus (not shown) which is operable to deliver a pressure differential from the pump to the grooves **59**. The outer surface of the cylindrical wall **55** of the intermediate drum **25** comprises grooves **59** running parallel to the cylindrical axis of the intermediate drum **25** and spaced around the circumference of the intermediate drum **25**. Each groove **59** is configured to receive a smoking article **1**. A first part **59***a* of each groove is formed on the first drum section **52**. A second part **59***b* of each groove **59** is formed on the second drum section **53**. The first and second parts **59***a*, **59***b* of each groove **59** are aligned with each other. For illustrative purposes cigarettes are shown held in a number of the grooves **59** in FIG. **3**.

[0063] The intermediate drum **25** comprises air ports **67** aligned with the grooves **59**. Each air port **67** comprises a hole through the cylindrical wall **55** of the intermediate drum **25**.

[0064] The pump (not shown) is configured such that, when operated, it will generate a first air pressure which is lower than the ambient air pressure at the outer surface of the intermediate drum **25** and a second air pressure which is higher than the ambient air pressure at the at the outer surface of the intermediate drum **25**.

[0065] The microwave detector station **50** includes the first and second microwave sensor units **51**, **51'**. The first and second microwave sensor units **51**, **51'** are generally the same and so one microwave sensor unit **51** will be described herein in detail. The use of microwaves helps to minimize any adverse effects occurring due to detection of the condition of the inserted object **36**, **36'**. The microwave sensor unit **51** comprises a microwave transmitter **68** and a microwave receiver **69**. The transmitter **68** and receiver **69** are spaced apart from each other. The transmitter **68** acts as a first detector unit. The receiver **69** acts as a second detector unit. A detection space or area **70** is defined between the

transmitter **68** and receiver **69**. Detection space or area **70** is configured to allow the object to be inspected to be received therein so that properties of the object can be detected. The transmitter **68** is disposed on one side of the arced path of the pair of cigarettes **22**, **22'**. The receiver **69** is disposed on the other side of the arced path of the pair of cigarettes **22**, **22'**. The transmitter **68** and receiver **69** are spaced apart to allow the passage of each of the pair of cigarettes **22**, **22'** to pass therebetween.

[0066] In the present arrangement, the transmitter **68** is disposed outside the diameter of the arced path of the pair of cigarettes **22**, **22'**. The transmitter **68** is mounted relative to the intermediate drum **25** and stationary collar. The transmitter **68** is mounted independently of the intermediate drum **25** and stationary collar **61**. Alternatively, the transmitter **68** is mounted to the support **62** extending from the stationary collar **61**. It will be understood that the stationary collar **61** is spaced from the path of the pair of cigarettes **22**, **22'**. The receiver **69** is received in the recess **63** in the stationary collar **61**. That is, the receiver **69** is disposed within the diameter of the arced path of the pair of cigarettes **22**, **22'**. The receiver **69** is aligned with the transmitter **68** so that the receiver **69** receives emitted microwaves from the transmitter **68**. The transmitter **68** remains stationary. That is, the intermediate drum **25** rotates relative to the transmitter **68**. The receiver **69** remains stationary. That is, the intermediate drum **25** rotates relative to the receiver **69**.

[0067] Although in the present arrangement, as shown in FIGS. **3** to **5**, the transmitter **68** is disposed outside the diameter of the arced path of the pair of cigarettes **22**, **22'** and the receiver **69** is received in the recess **63** in the stationary collar **61**, it will be understood that alternative embodiments are possible. One such embodiment is shown in FIG. **6**. In this embodiment, the positions of the transmitter **68** and the receiver **69** of each of the microwave sensor units **51**, **51'** are reversed. The receiver **69** is disposed outside the diameter of the arced path of the pair of cigarettes **22**, **22'**. The transmitter **68** is mounted inside the diameter of the arced path of the pair of cigarettes **22**, **22'**. In such an arrangement, the receiver **69** acts as a first detector unit and the transmitter **68** acts as a second detector unit. Although in the above embodiments the transmitters **68** of the first and second microwave sensor units **51**, **51'** are grouped together and the receivers **69** of the first and second microwave sensor units **51**, **51'** are grouped together, it will be understood that in alternative embodiments the receiver **69** of the second microwave sensor unit **51'** may be grouped with the transmitter **68** of the first microwave sensor unit **51**.

[0068] The transmitter **68** and receiver **69** of the first microwave sensor unit **51** are aligned to inspect the properties of the inserted object **36** of filter rod segment **24**. That is, the first microwave sensor unit **51** is positioned so that the inserted object **36** of filter rod segment **24** passes through the detection space **70** of the first microwave sensor unit **51** as it is rotated by the intermediate drum **25**. It will be understood that the filter rod segment **24** will pass through the detection space **70** in a transverse direction to the longitudinal axis of the filter rod segment **24**. This provides for the microwave sensor unit **51** to detect across the width of the filter rod segment **24**.

[0069] The transmitter **68** and receiver **69** of the second microwave sensor unit **51'** are aligned to inspect the properties of the inserted object **36'** of filter rod segment **24'**. That is, the second microwave sensor unit **51'** is positioned so that the inserted object **36'** of filter rod segment **24'** passes through the detection space **70** of the second microwave sensor unit **51'** as it is rotated by the intermediate drum **25**. It will be understood that the filter rod segment **24'** will pass through the detection space **70** of the second microwave sensor unit **51'** in a transverse direction to the longitudinal axis of the filter rod segment **24'**. This provides for the second microwave sensor unit **51'** to detect across the width of the filter rod segment **24'**.

[0070] Although in the above described embodiment the first and second microwave sensor units **51**, **51'** have separate transmitters **68**, it will be understood that, in an alternative embodiment, the transmitters **68** of the first and second microwave sensor units **51**, **51'** may be integrally formed with each other. Although in the above described embodiment the receivers **69** of the first and second microwave sensor units **51**, **51'** are integrally formed with each other, it will be understood that, in an alternative embodiment, the receivers **69** of the first and second microwave sensor units **51**, **51'** may be separate.

[0071] During operation of the cigarette making machine, the cut cigarettes **22**, **22'** are fed onto the periphery of the intermediate drum **25**. The cigarettes **22**, **22'** are fed from the final cut roller **20**. The intermediate drum **25** transports the cigarettes **22**, **22'** along an arcuate path. The cigarettes **22**, **22'** are therefore received by the microwave detector station **50**. The detection space **70** of each microwave sensor unit **51**, **51'** is aligned with the path of a corresponding filter rod segment **24**, **24'** of one of the cigarettes **22**, **22'**. As the filter rod segment **24**, **24'** passes through the detection space **70**, the microwave sensor unit **51** is operable to detect a property of the inserted object **36**, **36'**. For example, the microwave sensor unit **51** is operable to detect one or more of whether the inserted object **36**, **36'** is present, whether the inserted object **36**, **36'** is intact, whether the inserted object **36**, **36'** is filled with fluid, and/or whether the inserted object **36**, **36'** is leaking, or has leaked, its contents.

[0072] It will be understood that the microwave sensor unit **51** is operable on a periodic basis. That is, the transmitter **68** is operated either on a timed basis to correspond to the passage of the filter rod segment **24**, **24'** through the detection space **70**, or when it is determined that the filter rod segment **24**, **24'** will be passing through the detection space **70**. Alternatively, the transmitter **68** is operable on a continuous basis. As the cigarettes **12**, **12'** are fed successively through the microwave detector station **50**, the filter rod segments **24**, **24'** pass through the detection space **70** in a transverse direction to their longitudinal axis. The microwave sensor units **51**, **51'** carry out an inspection of the condition of the inserted objects **36**, **36'** of the manufactured cigarettes received in grooves **2** of the intermediate drum **25**. The processor P compares the data from the microwave sensor units **51**, **51'** with stored information corresponding to quality control criteria. The processor P is therefore able to determine whether each filter rod segment **24**, **24'** meets the quality control criteria.

[0073] The processor P is configured to determine whether the inserted objects **3**, **36'** in the filter rod segment **24**, **24'** are intact or damaged. In the present embodiment, the microwave detector station **50** is used to measure the moisture level. If the determined moisture level is too high or too low, this may indicate a damaged capsule in the filter rod segment **24**, **24'** such that the cigarette should be rejected. The processor P then controls the diverter gate G, acting as a

diverting unit, depending on the outcome of the inspection, so that the cigarettes which meet the quality control criteria are fed in an accept path onto outlet drum **29** driven in synchronism with inspection drum **27** and then pass in the direction of arrow D onto an output conveyor (not shown) for packaging. The diverter gate G diverts rejected cigarettes so that they continue on a reject path around the inspection drum **27** and transfer onto the reject drum **30**. The diverting action of the gate G may be implemented or assisted by controlling or releasing a negative pressure that retains the cigarettes **22** in the grooves **2** on the inspection drum **27**. A different control means and/or discharge means may be used together with the microwave detector station **50**. For example, in embodiments the microwave detector unit **51** includes its own diverter unit (not shown) which is operable to divert rejected cigarettes. In such an embodiment, the processor P is configured to control the diverter unit depending on the outcome of the inspection performed by the microwave detector station **50** to reject damaged capsules.

[0074] Although embodiments of a microwave detector station are described above with reference to FIGS. **3** to **6**, it will be understood that alternative embodiments are possible. Referring now to FIG. **7**, an alternative embodiment of a microwave detector station **100** is shown. The microwave detector station **100** shown in FIG. **7** is generally the same as the embodiments of the microwave detector station **50** described above and so a detailed description will be omitted herein. Furthermore, features and components of the microwave detector station **100** of the present embodiment corresponding to features and components of the microwave detector station **50** described above will retain the same terminology and reference numerals. However, in the microwave detector station **100** shown in FIG. **7** a different type of microwave sensor unit **101** is used.

[0075] In FIG. **7** the microwave sensor unit **101** is a planar resonator. The planar resonator removes the need to have separate transmitter and receiver modules. Therefore, the planar resonator is able to be positioned on one side of the path of the pair of cigarettes **22**, **22'**. Therefore, it is not necessary to ensure that separate modules are orientated correctly relative to each other. The planar resonator, acting as the microwave sensor unit **101** has a detection space **102**. The detection space **102** is disposed so that it coincides with the path of the inserted object of a filter rod segment. The corresponding filter rod segment passes through this detection space in a transverse direction to its longitudinal axis. In the arrangement shown in FIG. **7** the planar resonator is disposed outside the diameter of the path of the inserted object of filter rod segment. However, in another arrangement the planar resonator may be disposed inside the diameter of the path of the inserted object of filter rod segment.

[0076] Although embodiments of a microwave detector station are described herein with the intermediate drum **25**, it will be understood that the microwave detector station may be used together with one of the other conveyor drums within the smoking article making machine. For example, the microwave detector station **50** may be used with one of conveyer drums **8**, **10**, **11**, **17**, **19**, **20**, **26**, **27**, **29**, **30** of the cigarette making machine. Furthermore, in an embodiment in which the microwave detector station is provided downstream of the turning drum **26** then only one microwave sensor unit will be required because all of the inserted objects of the filter rod segments will be aligned. This minimises the hardware that is needed to inspect the inserted objects.

[0077] Although embodiments of a microwave detector station are described above with a conveyor drum, it will be understood that alternative embodiments are possible. The cigarettes may be conveyed along part the smoking article assembly path by an alternative mechanism. Referring now to FIG. **8**, an alternative embodiment of a microwave detector station **110** is shown. The microwave detector station **110** shown in FIG. **8** comprises a conveyer belt arrangement **111**. In the present embodiment, the microwave detector station **110** also comprises the inspection drum **27** and the outlet drum **29**. However, it will be understood that the microwave detector station **110** may be disposed at another position along the smoking article assembly path.

[0078] In the present embodiment as shown in FIG. **8**, the conveyor belt arrangement **111** includes a smoking article conveying section **112** on which smoking articles, in this case fully assembled smoking articles **22** are conveyed. The smoking article conveying section **112** conveys a linear path along which smoking articles **22** pass. The smoking articles **22**, and therefore the corresponding filter rod segment, travel in a transverse direction to its longitudinal axis.

[0079] A fork resonator **113** acts as the microwave sensor unit. The fork resonator **113** is disposed along the linear path. The fork resonator **113** comprises two arms **114**, **115**. A detection space **116** is defined between the two arms **114**, **115**. The smoking article conveying section **112** of the conveyor belt arrangement in extends through the detection space **116**. Therefore, the linear path along which smoking articles **22** pass extends through the detection space **116**, and so the detection space **116** coincides with the path of the inserted object of filter rod segment. The fork resonator **113** removes the need to have separate transmitter and receiver modules.

[0080] As cigarettes **22** are fed successively around the inspection drum **27** and fed onto the conveyor belt arrangement iii. The cigarettes **22** then successively pass along the smoking article conveying section **112** through the detection space **116** defined by the fork resonator **113**. The corresponding filter rod segment pass through this detection space **116** in a transverse direction to its longitudinal axis. The fork resonator **113** carries out an inspection of the inserted object of filter rod segment. The fork resonator **113** feeds data to the processor P which compares it with stored information corresponding to predefined criteria. The processor then controls the outlet drum **29**, acting as a diverting unit, depending on the outcome, so that the cigarettes which meet the quality control criteria are fed in an accept path onto an output conveyor **115** for packaging. The rejected cigarettes are not picked up by the outlet drum **29**, and so they continue on a reject path of the conveyor belt arrangement in and transfer into a reject bin **116**. The diverting action of the outlet drum **29**, acting as a diverting unit, is implemented or assisted by controlling a negative pressure that holds and retains the cigarettes **22** in the grooves **2** on the outlet drum **29**.

[0081] It will be recognized that in embodiments of the cigarette making machine, the or each microwave sensor unit may be disposed at any point online on the cigarette making machine. That is, at any point along the smoking article assembly path of the cigarette making machine between the filter rods being received by the cigarette

making machine and the assembled smoking article being discharged from the cigarette making machine.

[0082] In the above described embodiments, one microwave sensor unit is disposed along the assembly path and configured to provide an indication of one or more properties of an inserted object in each filter rod passing transversely along the smoking article assembly path through the microwave sensor unit. For example, in the embodiments described with reference to FIGS. **3** to **6**, the microwave sensor unit for providing an indication of each filter rod comprises one microwave transmitter and one corresponding microwave receiver acting together as a sensing arrangement. However, it will be understood that in an alternative embodiment two or more microwave sensor units are disposed along the assembly path, the two or more microwave sensor units being configured to provide an indication of one or more properties of an inserted object in each filter rod passing transversely along the smoking article assembly path through the microwave sensor units. It should be understood that the number of microwave receivers and microwave transmitters may vary.

[0083] In an arrangement with two microwave sensor units arranged to detect each filter rod passing transversely along the smoking article assembly path through the microwave sensor units, the microwave sensor units are disposed across the path of each filter rod. That is, the microwave sensor units form an array arranged transverse to the path of each filter rod. In an arrangement in which each microwave sensor unit comprises one microwave transmitter and one microwave receiver, the microwave receivers form an array arranged transverse to the path of each filter rod and the corresponding microwave transmitters are disposed across the path of each filter rod to form an array arranged transverse to the path of each filter rod. The array of microwave transmitters and the array of microwave receivers are aligned with each other.

[0084] The microwave sensor units are disposed adjacent to each other and are configured to provide an indication of one or more properties of an inserted object in each filter rod at two or more points along or adjacent to the path of each filter rod. That is, each microwave sensor unit is disposed to provide detection at a different point along the longitudinal axis of the filter rod. This provides redundancy in the event that one of the microwave sensor units is restricted from providing feedback.

[0085] Furthermore, in one embodiment one or more of the microwave sensor units are disposed adjacent to the path of each filter rod. That is, said microwave sensor unit may be aligned with a rod, such as a tobacco rod, disposed adjacent to the filter rod. Such a microwave sensor unit is configured to provide an indication of the property of an inserted object in the filter in dependence on the effect on the adjacent rod. For example, by said microwave sensor unit aligned with the adjacent rod determining the moisture level of the adjacent rod it is possible to determine whether liquid has been transferred to the adjacent rod from the inserted object. This arrangement, helps to provide an indication of one or more properties of an inserted object in each filter rod when a material which obscures detection using microwave sensing means, such as charcoal, forms part of the filter rod. Therefore, it is possible to indirectly determine a property of an inserted object.

[0086] One or more microwave sensor units in the array may be selectively switched off, depending on the properties being sensed. For example, if there is only one capsule or inserted object in a filter rod, only one sensor in the array need be activated. The number of microwave sensors that are operable can depend on the number of capsules or inserted objects in a filter rod, with any redundant sensors in the array being selectively deactivated.

[0087] It should also be understood that, by providing an array of microwave sensor unit disposed along the assembly path and configured to provide an indication of one or more properties of an inserted object in each filter rod passing transversely along the smoking article assembly path through the microwave sensor units, it is possible to allow for misalignments of the filter rods in a longitudinal direction.

[0088] 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 a superior smoking article assembly machine and/or method of assembling a smoking article on a smoking article assembly machine. 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.

1. A smoking article assembly machine comprising:

a filter rod receiving section configured to receive filter rods containing an inserted object,

an assembled smoking article discharge section,

a smoking article assembly path between the filter rod receiving section and the assembled smoking article discharge section along which filter rods pass in a transverse direction to the longitudinal axis of filter rods, and

a microwave sensor unit through which filter rods pass in a transverse direction, the microwave sensor unit being disposed along the assembly path and configured to provide an indication of one or more properties of an inserted object in each filter rod passing transversely along the smoking article assembly path through the microwave sensor unit.

2. The smoking article assembly machine according to claim **1**, further comprising a conveyor drum arrangement including a rotatable drum configured to receive the filter rods, or at least partially assembled smoking articles including the filter rods, around its periphery and thereby to transport the filter rods along an arced path during its rotation, the microwave sensor unit being configured to provide an indication of one or more properties of an inserted object in each filter rod received by the rotatable drum.

3. The smoking article assembly machine according to claim **2**, wherein the microwave sensor unit comprises a first

detector unit and a second detector unit configured to provide an indication of one or more properties of an inserted object in each filter rod when each filter rod is interposed between the first detector unit and the second detector unit.

4. The smoking article assembly machine according to claim **3**, wherein the first detector unit is outside the diameter of the arced path of the filter rods, and the second detector unit is within the diameter of the arced path of the filter rods.

5. The smoking article assembly machine according to claim **3**, wherein the first detector unit is a microwave transmitter and the second detector unit is a microwave receiver.

6. The smoking article assembly machine according to claim **3**, wherein the first detector unit is a microwave receiver and the second detector unit is a microwave transmitter.

7. The smoking article assembly machine according to claim **3**, further comprising a base about which the rotatable drum is rotatable, wherein at least one of the first and second detector units is on the base.

8. The smoking article assembly machine according to claim **1**, wherein the microwave sensor unit comprises a planar resonator on the smoking article assembly path.

9. The smoking article assembly machine according to claim **2**, wherein the rotatable drum is an intermediate drum.

10. The smoking article assembly machine according to claim **1**, further comprising a linear conveyor arrangement configured to receive said filter rods, or at least partially assembled smoking articles including said filter rods, and thereby to transport said filter rods along a linear path, the microwave sensor unit being configured to provide an indication of one or more properties of an inserted object in each filter rod received by the linear conveyor arrangement.

11. The smoking article assembly machine according to claim **10**, wherein the microwave sensor unit comprises a fork resonator on the smoking article assembly path.

12. The smoking article assembly machine according to claim **1**, comprising at least two microwave sensor units configured to provide an indication of one or more properties of an inserted object in each filter rod at two or more points along or adjacent to the path of each filter rod.

13. The smoking article assembly machine according to claim **12**, wherein each of the at least two microwave sensor units are selectively operational, so that the number of operational microwave sensor units can be set to correspond to the number of inserted objects in each filter rod.

14. The smoking article assembly machine according to claim **1**, wherein the filter rod receiving section configured to receive filter rods containing an inserted object is a filter rod receiving section configured to receive filter rods containing a capsule.

15. The smoking article assembly machine according to claim **1**, wherein the microwave sensor unit is configured to be stationary during operation.

16. A method of assembling a smoking article on a smoking article assembly machine comprising

receiving a filter rod containing an inserted object,

assembling the smoking articles including the filter rod containing the inserted object, and

discharging the assembled smoking article,

the method further including passing filter rods in a transverse direction to the longitudinal axis of the filter rod through a microwave sensor unit to provide an indication of one or more properties of the inserted object in the filter rod passing in a transverse direction between receiving the filter rod and discharging the assembled smoking article.

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