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(54) **Smoking machine**

(57) A multi-port smoking machine (2) comprises a rotary valve (12); a plurality of static smoking article holders (4), each static smoking article holder (4) being in communication with a corresponding static port (10) disposed about the rotary valve (12); and a suction means. The rotary valve (12) is rotatable to selectively place each of the static ports (10) in communication with the suction means so that, in use, air is drawn through a smoking article placed in the corresponding static smoking article holder (4) towards the suction means to provide a puff.

A method of smoking a plurality of smoking articles comprises: placing smoking articles in a plurality of static smoking article holders (4), wherein each static smoking article holder (4) is in communication with a corresponding one of a plurality of static ports (10) disposed about a rotary valve (12); and taking puffs sequentially through the smoking articles in the plurality of static smoking article holders (4) by rotating the rotary valve (12) to bring each of the plurality of static ports (10) successively into communication with a suction means.

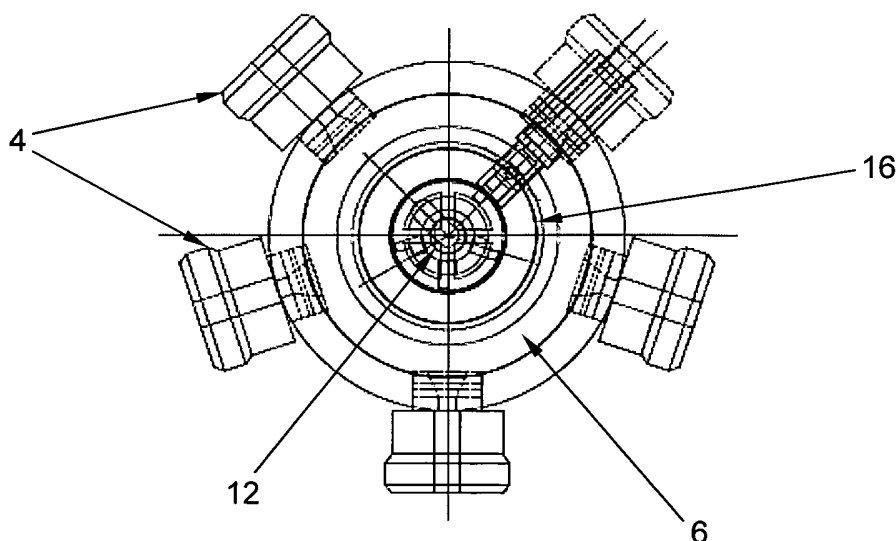


Figure 1a

Description

[0001] The present invention relates to a smoking machine, and more particularly to a multi-port smoking machine, and to a method of smoking a plurality of smoking articles.

[0002] Multi-port smoking machines for collecting and analysing the constituents of tobacco smoke produced by a plurality of cigarettes or other smoking articles under controlled smoking conditions are well known in the art. In use, the mouth end of the cigarettes are placed in holders connected to smoking ports on the machine, and air is drawn through the lit cigarettes at regular intervals using one or more mechanically driven gas syringes or pumps. Particulate and vapour phase constituents of the mainstream tobacco smoke drawn through the cigarettes are collected using one or more trapping systems, such as for example glass fibre (Cambridge) filters, impingers and gas collection bags, and then analysed to determine, for example, yields of tar, nicotine and carbon monoxide.

[0003] Two general types of multi-port smoking machines are known: linear smoking machines and rotary smoking machines.

[0004] In linear smoking machines, for example, the LM450 Linear Smoking Machine available from Borgwaldt KC in Hamburg, Germany, each smoking port is coupled to a separate syringe or pump, which draws air through a cigarette placed in a holder connected to that smoking port. In use, mainstream smoke is drawn simultaneously through each cigarette and collected separately, *i.e.* the mainstream smoke is collected individually per smoking port.

[0005] In rotary smoking machines, for example, the RM200A Rotary Smoking Machine available from Borgwaldt KC in Hamburg, Germany, the smoking ports are mounted on a head that is rotated relative to a single static syringe or pump, which draws air through cigarettes placed in holders connected to the smoking ports in turn. In use, the mainstream smoke drawn successively through each cigarette is collected cumulatively.

[0006] By allowing a cumulative mainstream smoke sample from a large number of smoking articles to be collected in a single run, rotary smoking machines advantageously generate a robust smoke matrix in a short period of time. However, while known rotary smoking machines are suitable for collecting smoke produced by conventional lit-end smoking articles, the rotation of the smoking ports during use can render them unsuitable for the collection of aerosols produced by alternative heated smoking articles.

[0007] A number of smoking articles in which tobacco material is heated to form an aerosol that is inhaled by a consumer, rather than combusted to form smoke, have been proposed in the art. In one known type of heated smoking article, an aerosol is produced by the transfer of heat from a combustible fuel element or heat source to a physically separate tobacco material, which may be located within, around or downstream of the fuel element.

[0008] In another, type of heated smoking article, tobacco material is heated by one or more electrical heating elements to produce an aerosol. Where the electrical heating elements are externally powered, the associated power cables may disadvantageously become entangled or dislodged during use of known rotary smoking machines as a result of the rotary motion of the smoking ports thereof.

[0009] It would be desirable to provide a rotary multi-port smoking machine that is suitable for collecting smoke produced by lit-end smoking articles and aerosols produced by heated smoking articles.

[0010] According to the present invention there is provided a rotary multi-port smoking machine comprising: a rotary valve; a plurality of static smoking article holders, each static smoking article holder being in communication with a corresponding static port disposed about the rotary valve; and a suction means. The rotary valve is rotatable to selectively place each of the static ports in communication with the suction means so that, in use, air is drawn through a smoking article placed in the corresponding static smoking article holder towards the suction means to provide a puff.

[0011] According to the invention there is also provided a method of automatically smoking a plurality of smoking articles comprising: placing smoking articles in a plurality of static smoking article holders, wherein each static smoking article holder is in communication with a corresponding one of a plurality of static ports disposed about a rotary valve; and taking puffs sequentially through the smoking articles in the plurality of static smoking article holders by rotating the rotary valve to bring each of the plurality of static ports successively into communication with a suction means.

[0012] The smoking article holders and corresponding ports of multi-port smoking machines according to the invention remain stationary during use. The risk of any power cables or other wires required to produce aerosols from heated smoking articles placed in the smoking article holders of multi-port smoking machines according to the invention becoming entangled or dislodged during use is thereby advantageously eliminated. As a result multi-port smoking machines according to the invention may advantageously be used to collect not only smoke produced by lit-end smoking articles, such as cigarettes, cigars, and cigarillos, but also aerosols produced by heated smoking articles (for example electrically heated cigarettes of the type disclosed in US-A-5,692,525 and heated cigarettes of the type disclosed in US-A-4,714,082).

[0013] The inclusion of a rotary valve also allows the dead volume between the plurality of smoking article holders of multi-port smoking machines according to the invention and the means for collecting smoke or other aerosols produced by smoking articles placed in the holders to be minimised. The dead volume is reduced and minimised because multi-port smoking machines according to the invention have a smaller footprint due to the use of the rotary valve, which reduces the distance

between the holders and the means for collecting the smoke or other aerosols. This advantageously reduces condensation and contamination of the smoke and other aerosols prior to collection as there is less surface area for the smoke and other aerosols to form on prior to reaching the collection means.

[0014] In addition, clogging in multi-port smoking machines according to the invention is advantageously reduced because contact between the components thereof during use removes particles that have formed on the interior surfaces of the machine. For example, where, as described below, the multi-port smoking machine according to the invention comprises a plurality of static smoking article holders mounted on a static ring, contact between a rotary disc used to move the rotary valve thereof and the static ring can remove particles that have formed on the interior surfaces of the machine.

[0015] In use, the rotary valve of multi-port smoking machines according to the invention is rotated in a step-wise manner against the suction means. As the rotary valve rotates the plurality of static ports are brought successively into communication with the suction means so that, in use, puffs are taken sequentially through smoking articles mounted in the corresponding plurality of static smoking article holders.

[0016] Multi-port smoking machines according to the invention may include any suitable known hydraulic, electrical, or electro-mechanical positioning means for indexing the rotary valve through a plurality of positions so as to bring the plurality of static ports successively into communication with the suction means. For example, the rotary valve may be indexed by means of an electric stepper motor or a pneumatic motor.

[0017] It will be appreciated that through an appropriate choice of rotary valve and positioning means, multi port-smoking machines according to the invention may comprise any desired number of static ports and corresponding static smoking article holders. Preferably, multi-port smoking machines according to the invention comprise between 2 and 40 static ports. More preferably, multi-port smoking machines according to the invention comprise between 5 and 20 static ports.

[0018] Multi-port smoking machines according to the invention may comprise any suitable suction means known in the art including, but not limited to, gas syringes and vacuum pumps.

[0019] To control the frequency, duration and volume of puffs taken from smoking articles placed in the plurality of static smoking article holders, multi-port smoking machines according to the invention may include known computer control systems coupled to the suction means and the rotary valve positioning means. For example, multi-port smoking machines according to the invention comprise computer control systems comprising a programmable logic controller (PLC) and a human-machine interface (HMI). By controlling the indexing of the rotary valve by the positioning means, the computer control system may also be used to select the number of static ports

of the multi-port smoking machine through which air is drawn in use. This advantageously allows puffs to be taken from smoking articles placed in all or only a pre-selected number of the plurality of static smoking article holders of multi-port smoking machines according to the invention.

[0020] Multi-port smoking machines according to the invention preferably further comprise: at least one central trap located between the ports and the suction means for collecting one or both of particulate phase components and vapour phase components of smoke or other aerosols produced by smoking articles placed in the smoking article holders.

[0021] Multi-port smoking machines according to the invention may comprise central traps for, in use, collecting (i) one or more particulate phase components or (ii) one or more vapour phase components or (iii) one or more particulate phase components and one or more vapour phase components of smoke and other aerosols produced by smoking articles placed in the holders thereof. Known trapping means that may be used as central traps to collect particulate phase components in multi-port smoking machines according to the invention include, but are not limited to, filters, such as glass fibre (Cambridge) filter pads and electrostatic precipitators. Known trapping means that may be used as central traps to collect particulate and vapour phase components in multi-port smoking machines according to the invention include, but are not limited to, impingers and cold traps.

[0022] The inclusion of at least one central trap in multi-port smoking machines according to the invention advantageously allows the collection of a cumulative smoke or aerosol sample from a plurality of lit-end or heated smoking articles in the smoking article holders *i.e.* the collection of a single sample from a plurality of ports. In preferred embodiments of the invention, the at least one central trap is releasably connected to the remainder of the multi-port smoking machine so as to allow easy removal and replacement thereof.

[0023] Alternatively or in addition, multi-port smoking machines according to the invention may further comprise: a plurality of peripheral traps, each peripheral trap being located between one of the plurality of smoking article holders and the corresponding port for collecting particulate phase components of smoke or another aerosol produced by a smoking article placed in the smoking article holder.

[0024] The inclusion of a plurality of peripheral traps in multi-port smoking machines according to the invention advantageously allows an individual smoke or other aerosol sample from each smoking article placed in the smoking article holders to be collected separately *i.e.* the collection of a single sample from a single port.

[0025] Known particulate phase trapping means that may be used as peripheral traps in multi-port smoking machines according to the invention include, but are not limited to, filters, such as glass fibre (Cambridge) filter pads.

[0026] The plurality of static smoking article holders and corresponding static ports are arranged around the rotary valve such that each of the static smoking article holders and corresponding static ports is equidistant from the rotary valve. Preferably, the plurality of static smoking article holders and corresponding static ports are disposed circumferentially about the rotary valve. More preferably, the plurality of static smoking article holders and corresponding static ports are equiangularly circumferentially spaced about the rotary valve.

[0027] Multi-port smoking machines according to the invention may comprise different static smoking article holders depending upon the type of smoking articles from which puffs are to be taken. For example, multi-port smoking machines according to the invention for use in collecting components of smoke drawn through lit-end cigarettes may comprise a plurality of static conventional cigarette holders with labyrinth seals, latex holders or vent blocking holders. In preferred embodiments of the invention, each of the plurality of static smoking article holders is releasably connected to the corresponding port so as to allow easy removal and replacement thereof.

[0028] Multi-port smoking machines according to the invention may further comprise components and features of linear and rotary smoking machines known in the art including, but not limited to, air-flow hoods, fume exhaust hoods, lighters and other ignition devices, ashtrays, butt length sensors, ejection mechanisms for automatically ejecting smoking articles from the plurality of smoking article holders and loading mechanisms for automatically placing smoking articles in the plurality of smoking article holders. For example, where the plurality of static smoking article holders and corresponding static ports are disposed circumferentially about the rotary valve, multi-port smoking machines according to the invention may further comprise an annular ashtray, which underlies the smoking article holders.

[0029] The invention will be further described, by way of example only, with reference to the accompanying drawings in which:

Figure 1a is a plan view of a multi-port smoking machine according to an embodiment of the invention; Figure 1b is a cross sectional view showing the rotary valve of the multi-port smoking machine of Figure 1a; Figure 2a is a plan view of the multi-port smoking machine of Figures 1a and 1b with a central particulate phase filter pad;

Figure 2b is a cross sectional view showing the rotary valve of the multi-port smoking machine of Figure 2a; Figure 3a is a plan view of the multi-port smoking machine of Figures 1a and 1b with a central particulate phase filter pad and peripheral particulate phase filter pads; and

Figure 3b is a cross sectional view showing the rotary valve of the multi-port smoking machine of Figure 3a.

[0030] A plan view of a multi-port smoking machine 2

according to an embodiment of the invention is shown in Figure 1a. The machine comprises five circumferentially spaced apart smoking article holders 4 mounted around the outer edge of a static ring 6. Each smoking article holder 4 is connected via a tubular duct 8 to a corresponding static port 10 along the inner edge of the static ring 6. At the centre of the static ring 6 is a rotary valve 12 for selectively connecting each of the ports 10 to a suction means (not shown) via a main tubular duct 14 so that a puff of a pre-selected duration and volume is taken from a smoking article placed in the smoking article holder 4 connected thereto.

[0031] As shown in Figure 1b, the rotary valve 12 comprises a five-position disc 16 and a positioning means 18. In use, the five-position disc 16 is indexed by the positioning means 18 between positions in which each of the five ports is in registration with the suction means. A control computer control system (not shown) is coupled to the rotary valve 12, the positioning means 18 and the suction means for, in use, controlling indexing of the five-position disc 16 by the positioning means 18 and hence the ports 10 through which air is drawn by the suction means. The control means also controls the frequency, duration and volume of puffs taken from smoking articles in the smoking article holders 4 through the ports 10.

[0032] A central circular glass fibre filter pad 20, 22 may be provided at the end of the main tubular duct 14 as shown in Figures 2a through 3b. As illustrated, the central glass fibre filter pad 20, 22 may vary in size. In use, as puffs are drawn sequentially through the ports 10 via the tubular ducts 8 by the suction means, the central glass fibre filter pad 20, 22 traps particulate phase components of the smoke or other aerosol produced by each of the smoking articles placed in the smoking article holders 4. In other embodiments (not shown), the central circular glass fibre filter pad 20, 22 may be replaced by a liquid impinger or cold trap that collects both particular phase components and vapour phase components of the smoke or other aerosol produced by each of the smoking articles placed in the smoking article holders 4.

[0033] Alternatively or in addition to one or more central traps, a peripheral circular glass fibre filter pad 24 may be provided between each smoking article holder 4 and corresponding port 10 of the multi-port smoking machine 2 as shown in Figures 3a and 3b. In use, as puffs are drawn from a smoking article placed in the smoking article holder 4 through the port 10 by the suction means, the peripheral glass fibre filter pad 24 traps particulate phase components of the smoke or other aerosol produced by the smoking article.

[0034] While the invention has been exemplified above with respect to a multi-port smoking machine with five ports, it will be appreciated that multi-port smoking articles may have other numbers of ports.

[0035] In addition, while the invention has been exemplified with respect to a multi-port smoking machine comprising central and peripheral glass fibre filter pads, it will be appreciated that multi-port smoking articles according

to the invention may comprise other particulate and vapour phase traps.

Claims

1. A multi-port smoking machine (2) comprising:

a rotary valve (12);
a plurality of static smoking article holders (4),
each static smoking article holder (4) being in
communication with a corresponding static port
(10) disposed about the rotary valve (12); and
a suction means,

wherein the rotary valve (12) is rotatable to selectively place each of the static ports (10) in communication with the suction means so that, in use, air is drawn through a smoking article placed in the corresponding static smoking article holder (4) towards the suction means to provide a puff.

2. A multi-port smoking machine (2) according to claim 1 further comprising:

at least one central trap (20, 22) located between the static ports (10) and the suction means for collecting one or both of particulate phase components and vapour phase components of puffs from smoking articles placed in the static smoking article holders (4).

3. A multi-port smoking machine according to claim 2 wherein the at least one central trap (20, 22) is a liquid impinger or a cold trap.

4. A multi-port smoking machine according to claim 1, 2 or 3 further comprising:

a plurality of peripheral traps (24), each peripheral trap (24) being located between one of the plurality of static smoking article holders (4) and the corresponding static port (10) for collecting particulate phase components of puffs from a smoking article placed in the static smoking article holder (4).

5. A multi-port smoking machine according to claim 4 wherein the peripheral traps (24) are glass fibre filter pads.

6. A multi-port smoking machine according to any of claims 1 to 5 further comprising:

a computer control system coupled to the rotary valve (12) for selecting which of the plurality of static ports (10) is placed in communication with the suction means.

7. A method of smoking a plurality of smoking articles comprising:

placing smoking articles in a plurality of static smoking article holders (4), wherein each static smoking article holder (4) is in communication with a corresponding one of a plurality of static ports (10) disposed about a rotary valve (12); and
taking puffs sequentially through the smoking articles in the plurality of static smoking article holders (4) by rotating the rotary valve (12) to bring each of the plurality of static ports (10) successively into communication with a suction means.

8. A method according to claim 7 further comprising:

collecting a cumulative sample of one or both of particulate phase components and vapour phase components of the puffs from the smoking articles using at least one central trap (20, 22) located between the static ports (10) and the suction means.

9. A method according to claim 7 or 8 further comprising:

collecting an individual sample of particulate phase components of the puffs from each of the smoking articles using a plurality of peripheral traps (24), wherein each peripheral trap (24) is located between one of the plurality of static smoking article holders (4) and the corresponding static port (10).

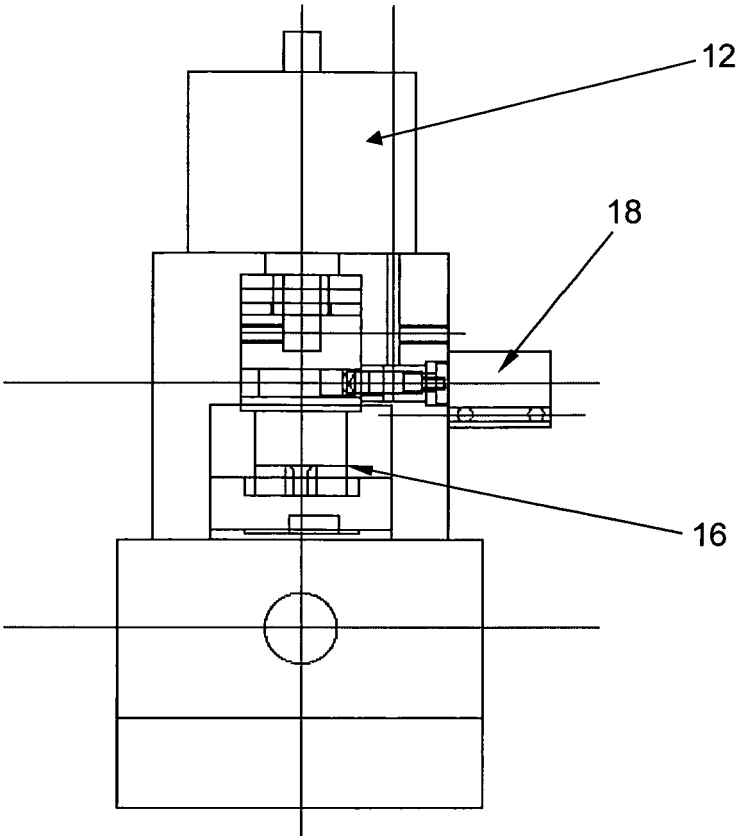


Figure 1b

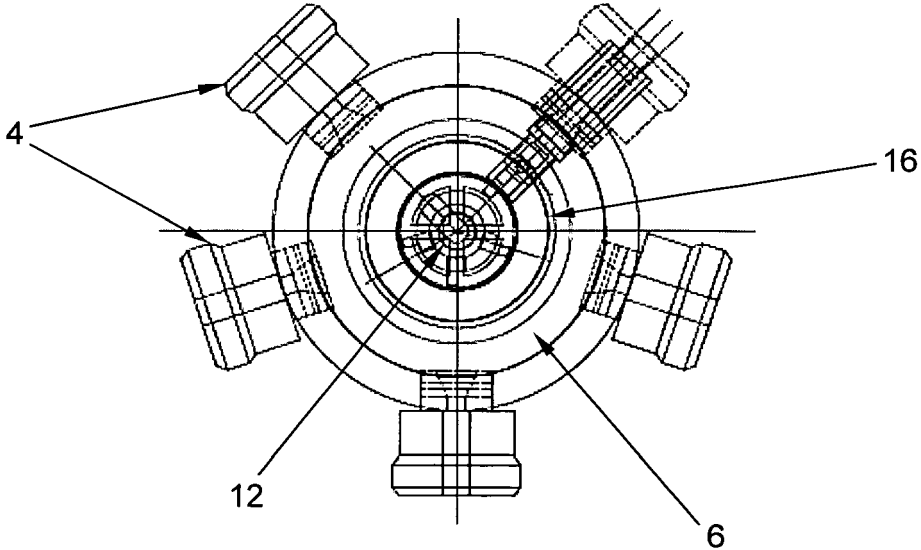
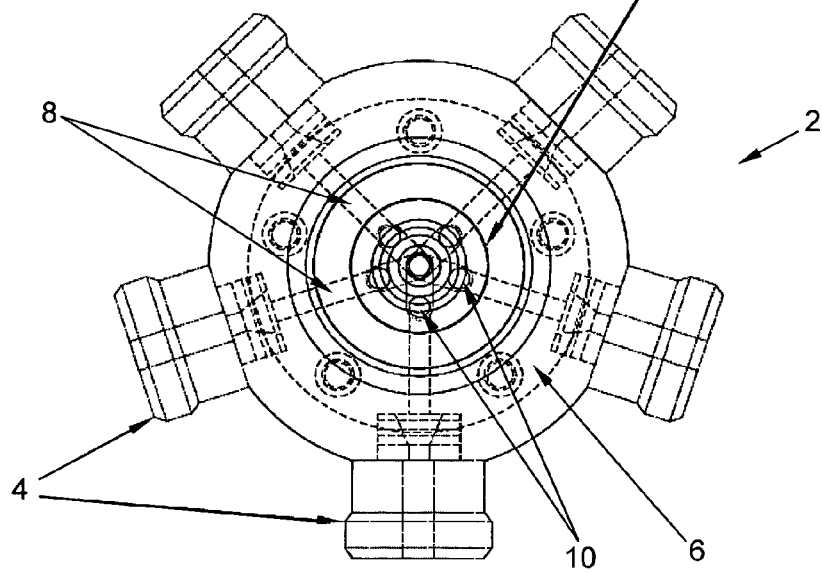
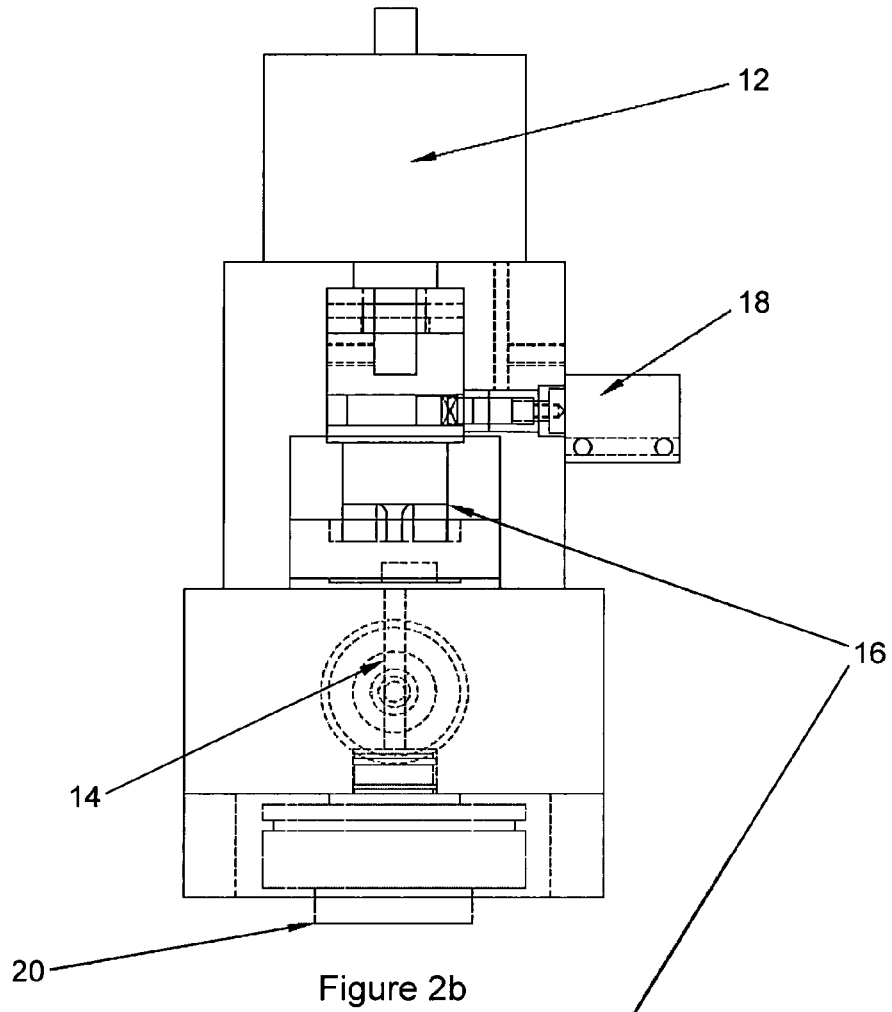


Figure 1a



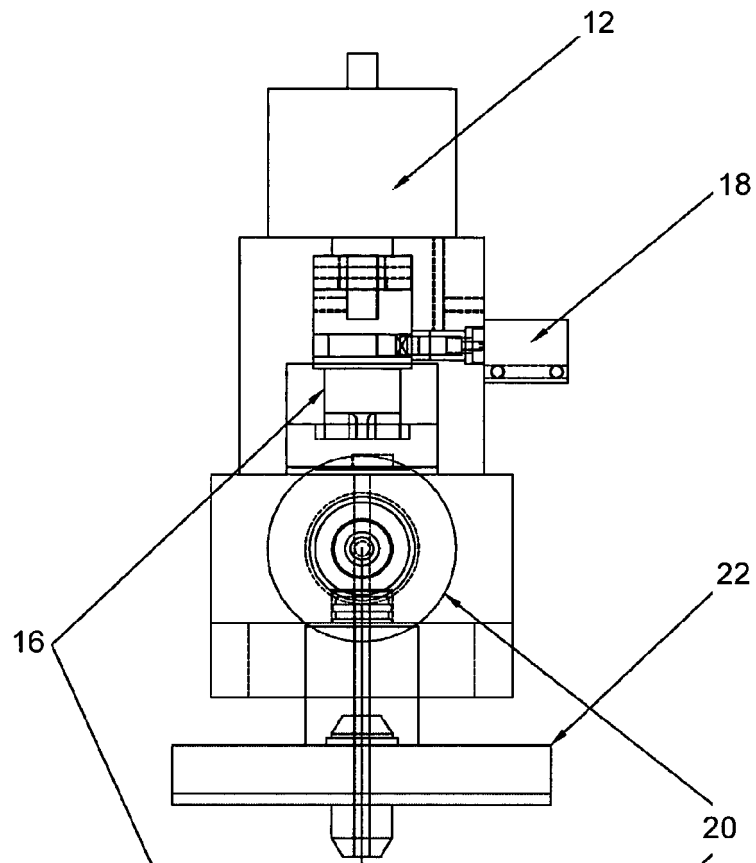


Figure 3b

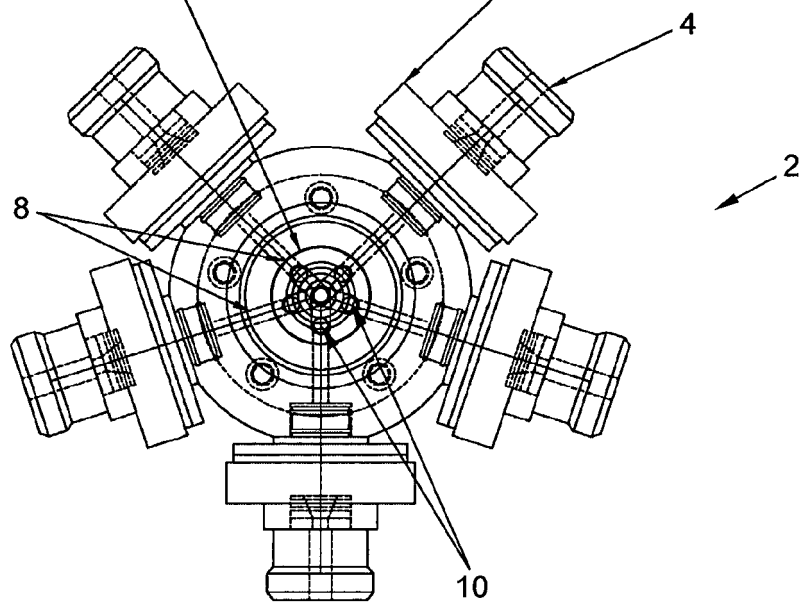


Figure 3a



EUROPEAN SEARCH REPORT

Application Number
EP 08 25 3905

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 May 2009	Examiner Marzano Monterosso
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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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