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(54) Device and method for measuring capsules in cigarette filters

(57) Device of the tobacco-processing industry, in particular a cigarette machine, that has a filter-affixing arrangement with a conveyor arrangement for cigarettes, characterized in that the conveyor arrangements conveys the cigarettes with affixed filters through a measuring region of a coaxial sensor, wherein the transport of the cigarettes takes place transversely to the longitudinal direction of the cigarettes.

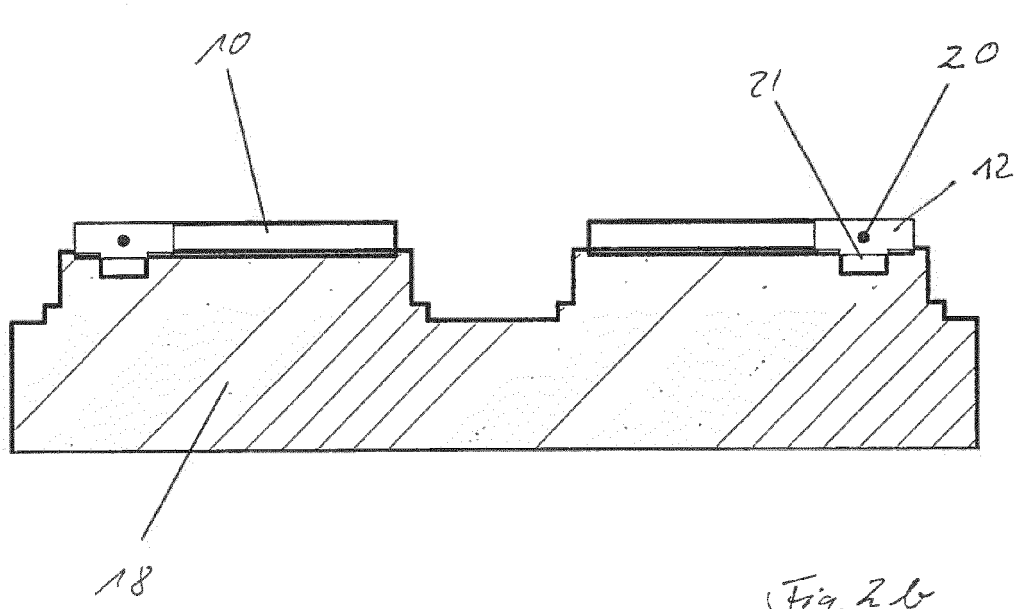

Fig. 2b

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Description

[0001] The present invention relates to a device as well as a method for measuring capsules in cigarette filters, in particular in moving cigarette filters.

[0002] In industrial moisture measurement technology, microwave resonators are used for a plurality of purposes. For example, microwave resonators determine the shift of a resonance frequency and the widening of a resonance curve based on the dielectric properties of a sample inserted in the resonator cavity or its stray field. From the change in the resonance frequency and/or the broadening of the resonance curve, one can determine the dielectric properties of the samples and in particular their moisture and/or density.

[0003] From EP 2 207 027 A2, a method and a device have become known for measuring the mass and density and/or for measuring the moisture of portioned units. A microwave measuring instrument used for this purpose consists of a microwave resonator to generate at least a resonance mode in a locally bounded region and an analysis unit to analyze at least one of the characteristic values of the resonance mode. The microwave resonator is a cavity resonator.

[0004] From EP 1 467 191 A1, a method and a device have become known for determining the mass of portioned active ingredient units. In the measuring process using microwaves, the shift of the resonance frequency and the change in the width of the resonance curve is recorded in a cavity resonator, so that one can determine the mass of the individual active ingredient units. The microwave resonator used here is a cavity resonator.

[0005] From DE 10 2007 041 429 A1, a method and a device have become known for measuring a moisture value of dielectric materials, in which a shift of the resonance frequency is analyzed for at least two resonance modes having separate frequencies and a density-independent moisture value is calculated form the measured shifts of the resonance frequencies. The microwave resonator used here consists of two coaxial resonators with measurements taken in their stray field.

[0006] From DE 40 04 119 A1, a method has become known for measuring the moisture of a material using microwaves and a device for performing the method. The resonator used here is a cylindrical, closed resonator with which the moisture value of tobacco can be determined, for example.

[0007] From EP 1 739 411 A1, a device and a method have become known for detecting and screening out defective cigarettes. The cigarettes to be measured have their front ends run past a coaxial sensor to detect defects in the end region of the cigarettes, either on the cigarette tip or on the filter end. To avoid measurement errors, the end region is run past the coaxial sensor and made to contact it.

[0008] Besides inspecting the end region of cigarettes, there is also the need to not only measure the end region of the cigarettes, but to also perform precise measurements along the cigarette. Here, there exists the particular problem that a measuring region must be provided that is large enough to guide the cigarettes through it and is simultaneously localized enough to be able to measure an individual cigarette, especially if they are in close spatial proximity to each other.

[0009] The problem underlying the invention is to provide a device, as well as a method, for measuring capsules in filter cigarettes moving transversely to their longitudinal direction, that has a sufficiently large measuring region and simultaneously has a measuring region that is sufficiently localized to measure individual cigarettes having a small distance to adjoining cigarettes.

[0010] The problem according to the invention is solved by a device having the features from claim 1. Advantageous configurations form the subject matter of the subclaims.

[0011] The device according to the invention is provided and intended for the tobacco-processing industry. In particular, the device according to the invention pertains to a cigarette machine. The device has a filter-affixing arrangement with a conveyor arrangement for cigarettes. In regard to the filter-affixing arrangement, the cigarette rod and the filter rod are brought together in such a manner, that the filter is affixed to the cigarette and, where appropriate, connected to it. In doing so, the conveyor arrangement of the filter-affixing arrangement transports the cigarettes with the affixed filter at high speed transversely to the longitudinal axis of the cigarettes through a measuring region of the coaxial sensor. The invention involves on the one hand the knowledge that a preferred location for measuring capsules lies within the cigarette filter in the cigarette machine directly after affixing the filter. In the manufacturing of cigarettes and the affixing of the filters, it may occur that individual capsules break in the filter affixing arrangement, and thus that defective cigarettes are produced. By means of the measurement according to the invention in the conveyor arrangement of the filter affixing arrangement, these cigarettes can be reliably detected. In addition, there is the knowledge, that a coaxial sensor with its measuring region is sufficient to achieve reliable measurements in regard to the capsules. Accordingly, the spatial expansion of the stray field is smaller than the distance to adjoining cigarettes. To prevent damaging the cigarettes, the measurement can be done in a no-contact manner.

[0012] In a preferred configuration, the conveyor arrangement has a rotatable drum along whose circumference the cigarettes are arranged and protrude with at least part of their filter, to be guided through the measuring region of the coaxial sensor. In regard to the rotatable drum of the conveyor arrangement, the cigarettes can be positioned in such a way, that the filter protrudes over the drum and is guided through the measuring region of the coaxial sensor. Since a coaxial sensor is generally built small, such a one can be easily arranged in the vicinity of the rotatable drum. Also, the stray field of a coaxial sensor is sufficiently localized, so that cigarettes

arranged on a drum do not interfere with each other.

[0013] Alternatively, the drum can also be equipped with a circumferential recess in the manner of a ring groove, which creates a space under the cigarette filter. A measurement with a coaxial sensor directed at the cigarette filter is not disrupted by the material of the drum.

[0014] In a preferred configuration, the conveyor arrangement has a second rotating drum with a second coaxial sensor. The two, preferably counter-rotating, drums are arranged in such a manner that the cigarettes are transferred from the first drum to the second drum and are measured on both coaxial sensors. By the cigarette going from a first drum over to a second drum, the cigarette is turned 180° relative to the drum. This means that a capsule not located in the center of the cigarette filter, which may possibly not have been recorded in a first measurement at the first drum, has subsequently changed its position relative to the sensor in the second measurement at the second drum, and can have said position recorded.

[0015] In an appropriate enhancement of the device according to the invention, the coaxial sensor records a change of the resonance frequency and/or a broadening of the resonance curve. By means of a preferably provided analysis unit, the measurement values recorded by each of the coaxial sensors can be analyzed when they cross through the maximum of the measurement field to determine a density value for the cigarette. The density value analyzed for the cigarette already offers good information in regard to what extent capsules, with aroma materials, incorporated in a cigarette filter are present. Also, the density values can give information for example about the presence of filter segments within the cigarette filter.

[0016] In a preferred enhancement, the analysis unit is configured in such a way to determine a moisture value for the cigarette in the maximum of the measurement field. The moisture value is particularly of interest when defective capsules with aroma substances are to be detected within a cigarette filter, because the interaction between the aroma substances and the microwave field are dependent on whether these are bound in a capsule or are distributed over the filament structure of the fiber material.

[0017] The problem underlying the invention is also solved by a method for measuring capsules in a cigarette filter. In the measurement method according to the invention, a measurement device is used, that has a coaxial sensor as a microwave resonator. The method according to the invention contains the method step: moving of cigarettes with their filters through a measuring region of the microwave resonator, wherein the movement direction is transverse to the longitudinal direction of the coaxial sensor. In this movement, the cigarette to be measured is run past the coaxial sensor in such a manner, that the contact direction is transverse to the longitudinal direction of the cigarettes. In a subsequent method step, the dielectric properties of a cigarette filter located in the measuring region are measured. The measured dielectric properties of the cigarette filter are analyzed in regard to the absence or presence of the capsule in the cigarette filter. A capsule incorporated into the cigarette filter consists of a different material than the filter tow, so that here other dielectric properties exist. Based on the change of the dielectric properties, one can then deduce whether the capsule is absent or present in the cigarette filter.

[0018] Preferably, the movement of the cigarettes occurs through the counter-rotation of the drums, each of which is assigned a microwave resonator designed as a coaxial sensor. In a preferred enhancement of the method, each cigarette is first measured at a first drum and then transferred to the second drum, where it is measured again. The advantage of two rotating drums lies in that when transferring the cigarette from the first drum to the second drum, it changes its orientation relative to the drum and thus relative to the associated coaxial sensor.

[0019] In a very practical enhancement, density and/or moisture values of a single cigarette to be inspected are compared with the average values of previous cigarettes. From the comparison, one can deduce whether there is a defective, in particular a recently defective, capsule if the values deviate from the average values by more than one of the predetermined differential values.

[0020] A preferred embodiment of the invention is explained in further detail using the following drawings.

Fig. 1	depicts the view into a cigarette machine on its feed rollers;
Figs. 2a and 2b	depict a cross-sectional, schematic view of a double feed roller with projecting filters and with a gap under the filter;
Fig. 3 3	depicts a schematic view of a measurement of a displaced cigarette;
Fig. 4	depicts sample measurement results for the density of an intact capsule, a capsule broken some time ago, and a missing capsule;
Fig. 5	depicts the measured density of an intact capsule and a just-broken capsule;
Fig. 6	depicts the measurement results for the density of a double capsule and an intact capsule.
Fig. 7	depicts the measured moisture of an intact capsule and a just-broken capsule; and
Fig. 8	depicts two counter-rotating drums with each having one coaxial sensor.

ilt

[0021] Fig. 1 depicts a view of a cigarette machine with a feed roller that transports cigarettes after affixing the filter. In the feed roller depicted in figure 1, the finished cigarettes are carried to the cigarette machine directly after affixing the filter. The feed rollers have a diameter of 23 cm for example, wherein the cigarettes have a clearance of approximately 1-2 cm in the circumferential direction on the feed rollers. Each cigarette 10, as depicted in figure 2, is held in its central region so that a cigarette head 12 and a filter head 14 protrude beyond holding region 16 of feed roller 18. An aroma capsule 20 is provided in cigarette filter 12. Aroma capsules are used in cigarettes and other tobacco products so that aroma substances do not burn, but can be inhaled unburned jointly with the tobacco smoke. Aroma capsules 20 contain mostly liquid aroma substances, such as menthol. Prior to smoking, the smoker crushes the aroma capsule in the filter so that the aroma substances are released in cigarette filter 12 and can be inhaled.

[0022] Measurements using microwaves on a feed roller, as depicted in figure 2a, represent a particular challenge for a measurement using a microwave sensor. On the one hand, cigarette filter 12 must be guided through the measuring region, although the space in an existing cigarette machine for a sensor is limited. On the other, the measuring region of the microwave resonator must be localized in the circumferential direction to such an extent that an individual cigarette can be measured. In doing so, it is important that given a one-centimeter clearance of the cigarette in the measuring region, the signals of various cigarettes can be separated.

[0023] Fig. 2b depicts a configuration of the drum-shaped feed roller 18 with a recess 21 under cigarette filter 12 and aroma capsule 20. By means of Recess 21, just as with the protrusion, one achieves the effect that the sensor is not disturbed by the material of drum 18 when taking its measurement.

[0024] Fig. 3 depicts a schematic view of a cigarette 3 with a cigarette filter 4 into which an aroma capsule has been incorporated. Coaxial sensor 1 is arranged near cigarette filter 4, wherein cigarette filter 4 is moved through the measuring region of the coaxial sensor. Each of the coaxial sensors 1 has a resonator housing 22, whose interior wall bounds resonator cavity 24. Pin 26 arranged in resonator cavity 24 defines the longitudinal direction of coaxial sensor 1. Resonator cavity 24 is enclosed by a cover 28. The depicted resonators are coaxial resonators that, contrary to cavity resonators, have a fundamentally different construction. Cavity resonators are constructed similar to waveguides and have a cut-off frequency. In contrast, the coaxial sensor has, like a coaxial cable, transversal electromagnetic waves (TEM waves) and consequently functions without a cut-off frequency. In coaxial sensor 1, measurements are taken in its stray field that, by through cover 28, forms the measuring region of the sensor outside of the sensor body.

[0025] Fig. 4 depicts an example of a density measuring process over the time period when a cigarette with an aroma capsule 2 in filter 4 is moved past the coaxial sensor. It can be clearly seen that for an intact capsule, a distinct maximum emerges (cf. curve 30). In contrast to that, the peak value of the density in curve 32 is not as pronounced, which can be attributed to the aroma capsule already being broken at an earlier point in time. For a missing capsule, there is an evenly distributed density value 34. By analyzing the density signals, one can readily determine whether an intact capsule 2 is present in the cigarette filter or not.

[0026] Besides the difference depicted in figure 4 regarding an intact capsule 30 and a capsule 32 broken some time before, one cannot differentiate between an intact capsule 36 and a just-broken capsule 38 if solely the density signal is taken into consideration.

[0027] As depicted in figure 6, there is also the possibility of detecting erroneously inserted dual capsules in a cigarette filter. The conveyor sequence labeled 40 depicts, that compared to an intact single capsule 42, a significantly greater amplitude value occurs in the density signal. This also matches the results from figure 4, according to which a double-capsule cigarette filter has a greater amplitude value.

[0028] Besides the density signal analysis described above, one can also analyze the moisture signals. For example, this is easily observed on a just-broken capsule 44 in figure 7 in that the moisture value clearly increases compared to intact capsule 46. Just-broken capsules can thus only be detected by means of the moisture value.

[0029] Fig. 8 depicts a specially preferred arrangement of two conveying drums 1, 1'. Conveying drums 1, 1' counter-rotate, wherein cigarettes 2 are transferred by conveying drum 1 at approximately the 12 o'clock position to conveying drum 1'. Each of the conveying drums has along the circumference receiving slots for the cigarettes to be conveyed, which are arranged at about half the depth into the receiving slot. The cigarettes then run counter-clockwise in the second conveying drum 1', starting at the 6 o'clock position. The cigarettes are initially measured at drum 1 at about the 9 o'clock position and at about the 3 o'clock position at conveying drum A'. By the transfer of the cigarettes, these are rotated relative to coaxial sensors 3 and 3' by 180° relative to the drum. Thus, if coaxial sensor 3 records the cigarettes in the receiving slot on drum 1 better in their exterior region, then this region is arranged radially inward in conveying drum 1' so that the remaining region of the cigarette filter is measured by coaxial sensor 3'.

[0030] Defective capsules (incorrect position, missing capsules, double capsules, just-broken capsules or those broken some time ago) can be determined very precisely, especially when the single value for density or moisture determined in the maximum of the measuring field is compared with the average density and moisture values of a certain number of previous cigarettes. If the individual value deviates excessively from this average value, the just measured cigarette is a cigarette with a

defective capsule.

[0031] The particular advantage when using a coaxial sensor is, that their relevant length and dimensions can be reduced to one-quarter of the wavelength of the resonance frequency. In this way, it is possible to provide for coaxial sensors given a small amount of space in the region of the feed roller. In addition, coaxial sensors have a measuring field that can be concentrated on a small volume of space so that there is sufficient spatial resolution that enables one to measure individual cigarette filters that can have a clearance of 1 cm or less.

Claims

1. Device of the tobacco-processing industry, in particular a cigarette machine, that has a filter-affixing arrangement with a conveyor arrangement for cigarettes, **characterized in that** the conveyor arrangements conveys the cigarettes with affixed filters through a measuring region of a coaxial sensor, wherein the transport of the cigarettes takes place transversely to the longitudinal direction of the cigarettes.

2. Device according to claim 1, **characterized in that** the conveyor arrangement has a rotatable drum along whose circumference the cigarettes are arranged and protrude with at least a section of their filter to be guided through the measuring region of the coaxial sensor.

3. Device according to claim 1, **characterized in that** the conveyor arrangement has a rotatable drum along whose circumference the cigarettes are arranged, wherein at least for each cigarette a recess is provided in the region of the cigarette filter.

4. Device according to claim 2 or 3, **characterized in that** the conveyor arrangement has a second rotating drum and a second coaxial sensor, wherein the cigarettes are transferred from the first drum to the second drum and are measured by both coaxial sensors..

5. Device according to one of the claims 1 to 4, **characterized in that** the coaxial sensor records a change in the resonance frequency and/or a broadening of the resonance curve.

6. Device according to one of the claims 1 to 5, **characterized in that** the cigarettes are run past the coaxial sensor without contacting it.

7. Device according to one of the claims 1 to 6, **characterized in that** an analysis unit is provided, that analyzes the measurement values recorded by the coaxial sensor to determine a density value for the cigarette.

8. Device according to one of the claims 1 to 7, **characterized in that** the analysis unit determines a moisture value for the cigarette.

9. Method for measuring a capsule in a cigarette filter with a microwave resonator designed as a coaxial sensor that comprises the following method steps:

   - Moving of cigarettes with their filters through a measuring region of the microwave resonator, wherein the movement direction through the measuring region occurs transversely to the longitudinal direction of the cigarettes,
   - Measuring of dielectric properties of a cigarette filter located in the measuring region,
   - Analysis of the measured dielectric properties of the cigarette filter in regard to the absence or presence of the capsule in the cigarette filter.

10. Method according to claim 9, **characterized in that** the measured dielectric properties of the cigarette filter are analyzed in regard to its density.

11. Method according to claim 9 or 10, **characterized in that** the measured dielectric properties of the cigarette filter are analyzed in regard to its moisture.

12. Method according to one of the claims 9 to 11, **characterized in that** the measured dielectric properties are analyzed in regard to defective capsules and/or excessive number of capsules.

13. Method according to one of the claims 9 to 12, **characterized in that** the movement of the cigarettes takes place by counter-rotating drums, of which each has a microwave resonator designed as a coaxial sensor, wherein each cigarette is first measured on a first drum and then transferred to a second drum and measured there again.

14. Method according to one of the claims 9 to 13, **characterized in that** the average density and/or moisture values of one or several previous cigarettes are compared to the values of a currently measured cigarette to determine the condition of the capsule, wherein a defect is then detected when the deviations between averaged values and current measuring values exceed a predefined limit.

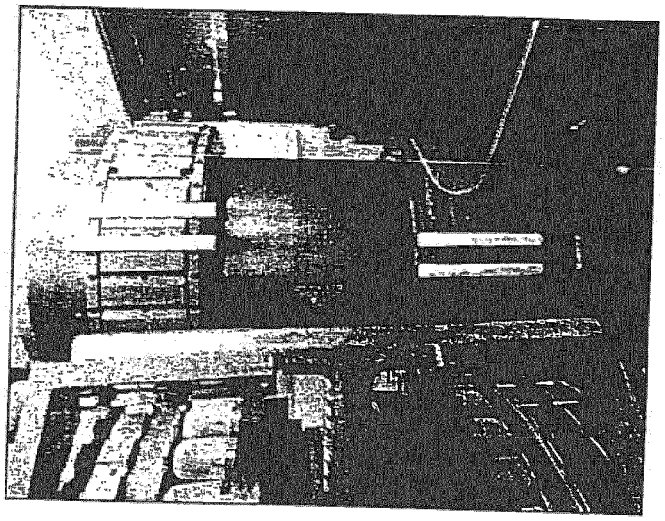


Fig. 1

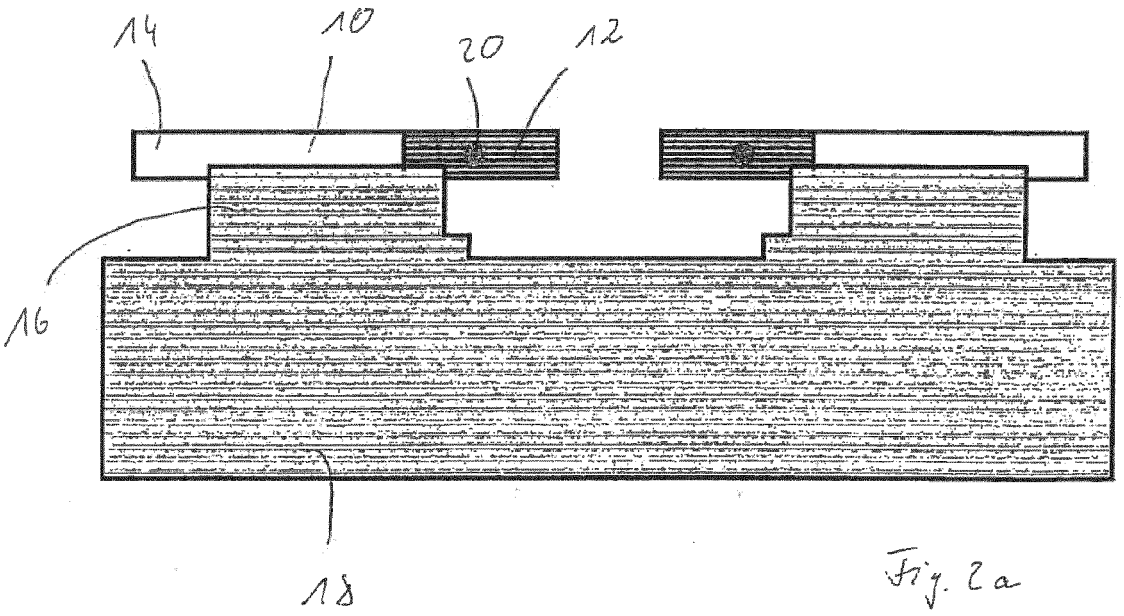


Fig. 2a

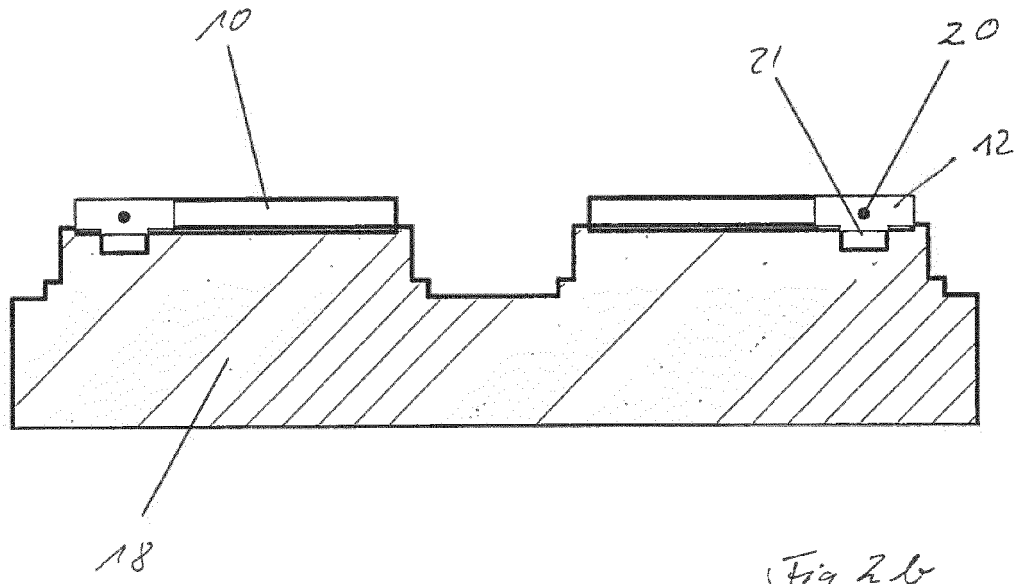
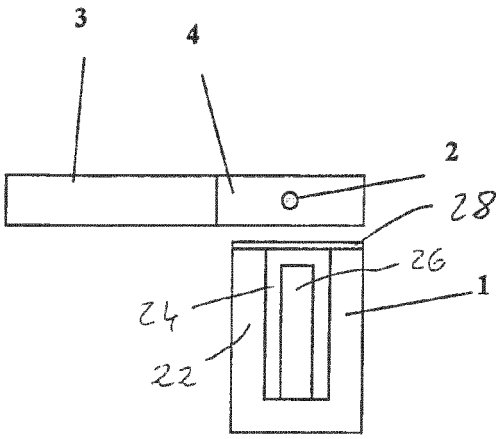


Fig. 2b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24
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22

Fig. 3

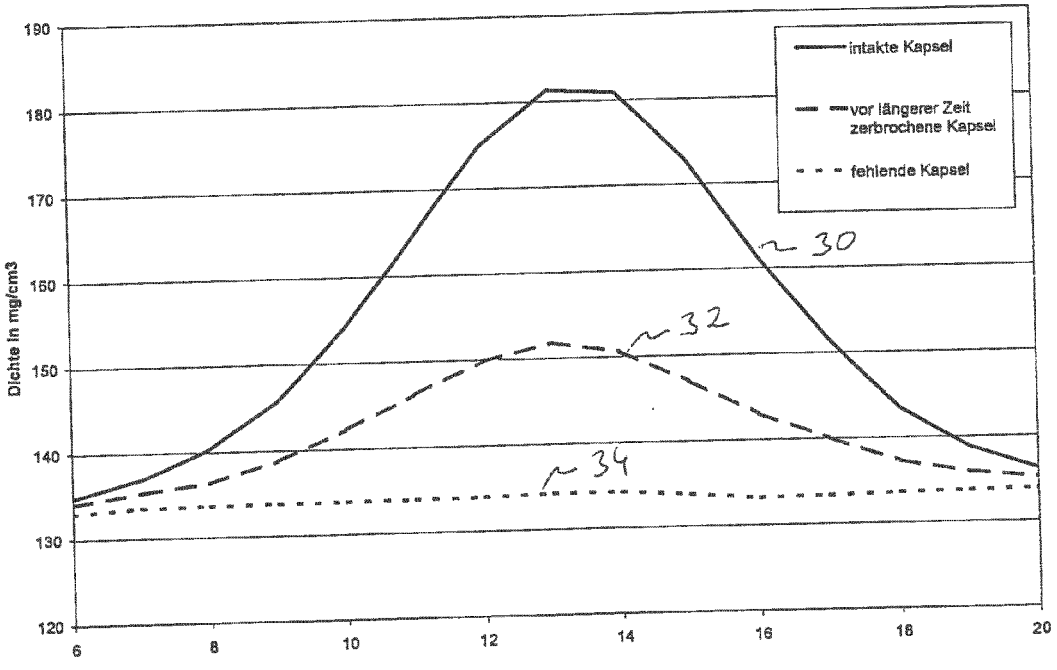
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Fig. 4

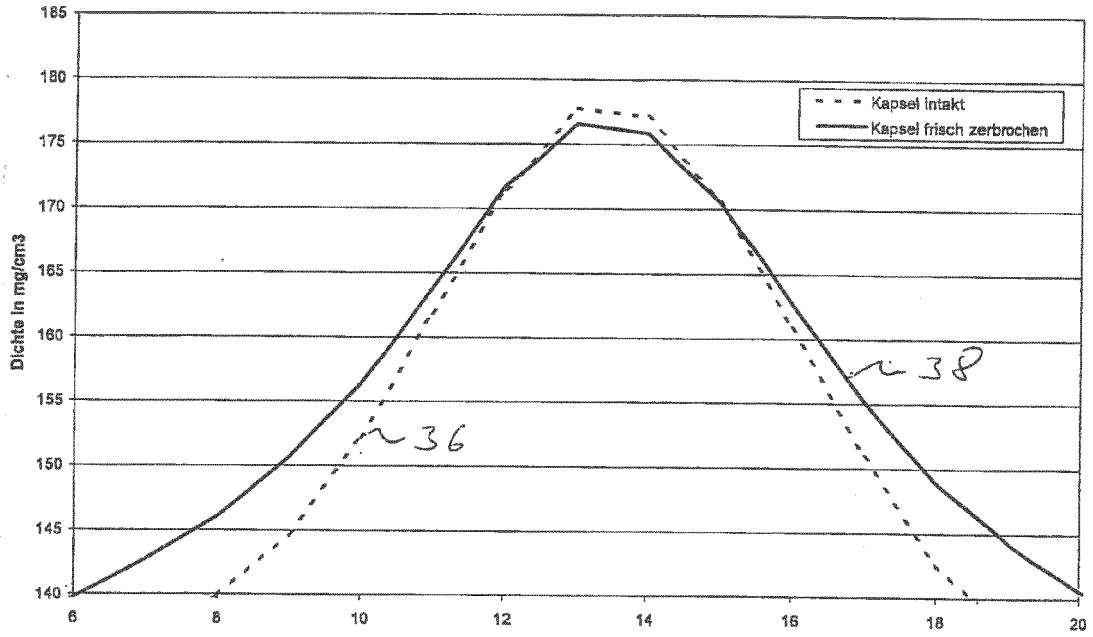
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Fig. 5

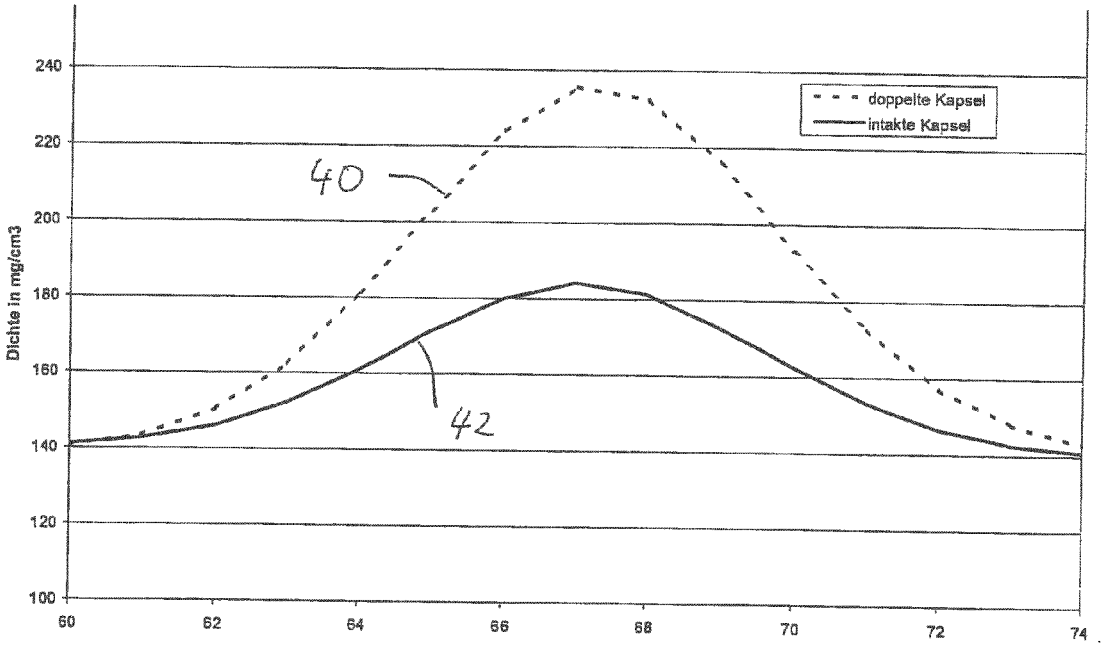
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Fig. 6

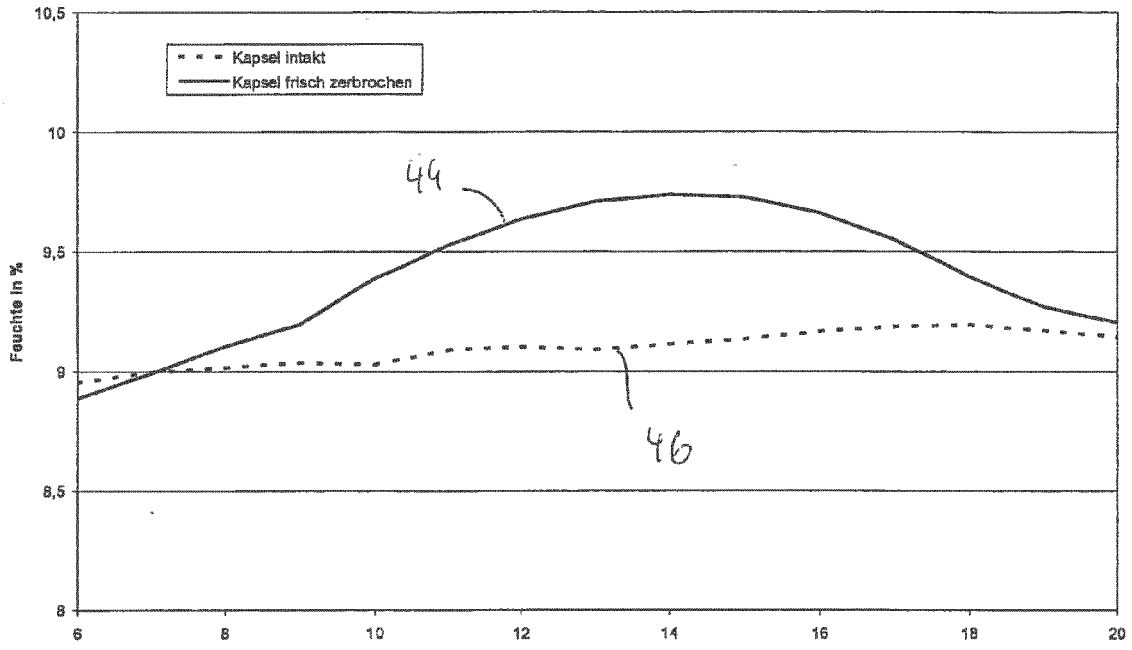
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Fig. 7

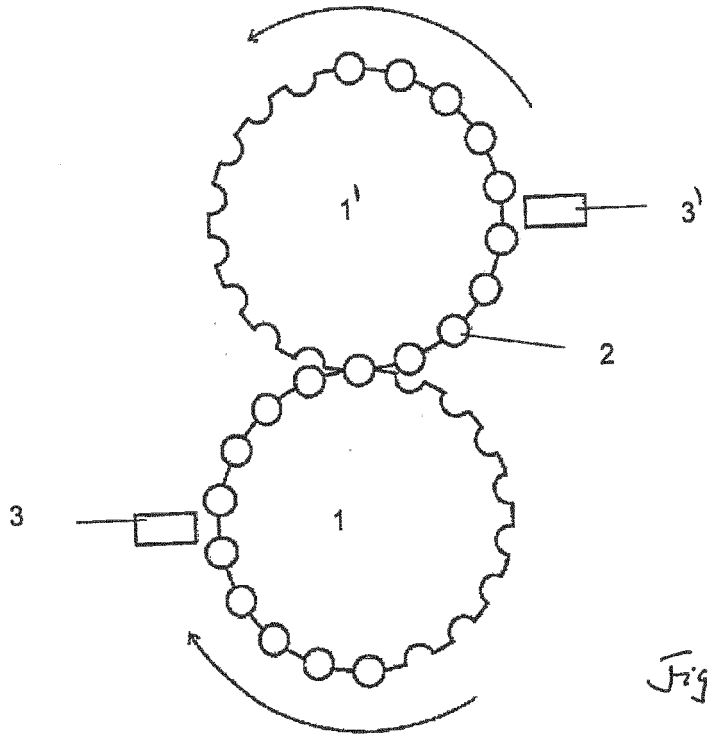
1'
3'
2
3
1

Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 13 00 2175

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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