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(54) CUTTING APPARATUS OF TOBACCO INDUSTRY, AND METHOD FOR DETECTING DAMAGE TO CUTTING KNIFE IN TOBACCO INDUSTRY

(57) The object of the application is a cutting apparatus (1) of the tobacco industry comprising: a bearing frame; a rotary cutting head (4) provided with cutting knives (6) situated on the circumference of the rotary cutting head (4), with the cutting knives (6) being situated principally parallel to the axis of rotation (X) of the rotary cutting head (4); a feeding conveyor (3a, 3b) adapted to feed a material (9) to be cut to the rotary cutting head (4); and a bed knife unit (5) situated between the conveyor (3a, 3b) and the rotary cutting head (4); characterised in that the cutting apparatus (1) further has a cutting apparatus (1) mechanical vibration monitoring system (15) comprising at least one vibration sensor (10), the monitoring system (15) being built and adapted in such a way that it is possible to detect vibration induced by the contact between the cutting knife (6) of the rotary cutting head (4) and the foreign body (8) being in the material (9) to be cut, whereas the monitoring system (15) also comprises a signal analyzer (20) and is connected with the cutting apparatus control system (1).

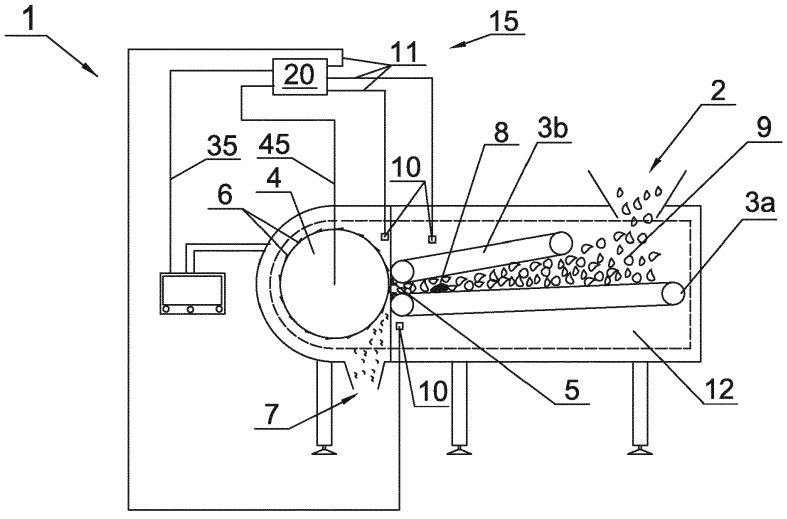


Fig. 1

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Description

[0001] The object of the invention is a cutting apparatus of the tobacco industry, and a method for detecting damage to a cutting knife in the tobacco industry.

[0002] The proposed solutions refer to an apparatus used to cut/shred materials, mainly of plant origin, especially tobacco, cloves and other materials to be used in smoking products.

[0003] The input material for the cutter is a material of plant origin in any of different forms, including in particular in the form of leaves or parts of leaves, veins of tobacco leaves, tobacco films, cigar filling, cut cigarette filling, tobacco debris (shavings) and/or crumbs as well as in every (any) combination of materials containing tobacco in any form. The moistened tobacco is delivered to a feeding apparatus/conveyor of the cutter using any method known in the prior art. An example tobacco treatment process may be carried out according to the method disclosed in the patent description US 5722431.

[0004] An effect of the cutting process carried out at the cutter is a cut tobacco or other material sliced and/or shredded according to the requirements and the production process parameters.

[0005] During the cutting process, it may happen that there are foreign bodies in the input material, e.g. stones, pieces of wood, metal elements or other hard objects which may cause damage to the knife in the form of cracking, chipping or blunting. There is a risk that a knife part broken off in such a way will get into the final product and cause a threat to a consumer of a tobacco industry product.

[0006] Moreover, such damage to the knife adversely affects the quality and repeatability of cutting, causing an irregularity in length and size of the pieces of cut material.

[0007] The patent description DE 10021614 discloses a tobacco cutter wherein the knife head frame and the main machine frame are connected with a hinge which allows a partial rotation or lifting of the knife head frame, whereas the main machine frame is permanently fixed to the ground. This solution shows a method and an apparatus for automatic sharpening of tobacco cutting knives.

[0008] The patent EP1532870 describes a tobacco cutter with an apparatus for detecting the cutting knife contact with the machine mouthpiece using a sound sensor. After the detection of the knife contact with the cutter mouthpiece by the apparatus used, a signal is sent to the sharpening apparatus which approaches the knife and grinds its cutting edge in order to eliminate the contact with the mouthpiece. A characteristic feature of the event being identified is the constant characteristic of vibration induced by the collision of the knife with the mouthpiece. Successive events occurring one after another are characterised by a high probability of generated sounds due to the fact that precisely known objects collide, and the collision conditions are highly similar.

[0009] None of the above solutions known in the prior art solves the problem of knife damage detection or the problem of presence of cutting blade parts in the already cut material. Sound effects occurring during the cutting knife damage resulting from the collision with a foreign body of unknown structure and physical properties may be inaudible to the operator being at a further distance from the machine. The sound effects accompanying the knife damage may be deafened by other sound effects occurring at the shop floor. The use of sound sensors and event detection based on sound analysis involves a number of difficulties in a noise polluted environment. Moreover, the above solutions do not solve the problem of irregular cutting of the material occurring during the cutting with a broken or chipped knife. In the solutions known so far in the prior art, the operator made conclusions concerning a potential occurrence of damage to the knives based on the bad quality of cut tobacco, which resulted in great material and financial losses.

[0010] The object of the invention is a cutting apparatus of the tobacco industry comprising: a bearing frame; a rotary cutting head provided with cutting knives situated on the circumference of the rotary cutting head, with the cutting knives being situated principally parallel to the axis of rotation of the rotary cutting head; a feeding conveyor adapted to feed a material to be cut to the rotary cutting head; and a bed knife unit situated between the conveyor and the rotary cutting head; characterised in that the cutting apparatus further has a cutting apparatus mechanical vibration monitoring system comprising at least one vibration sensor, the monitoring system being built and adapted in such a way that it is possible to detect vibration induced by the contact between the cutting knife of the rotary cutting head and a foreign body being in the material to be cut, whereas the monitoring system also comprises a signal analyzer and is connected with the cutting apparatus control system.

[0011] The apparatus according to the invention is further characterised in that the vibration sensor is an accelerometer.

[0012] The apparatus according to the invention is further characterised in that the vibration sensor has the operating frequency range between 0.3 Hz and 5 kHz.

[0013] The apparatus according to the invention is further characterised in that at least one first vibration sensor is situated in the area of the bed knife unit.

[0014] The apparatus according to the invention is further characterised by further comprising at least one second vibration sensor situated outside the area of the bed knife unit.

[0015] The apparatus according to the invention is further characterised in that the signal analyzer is adapted to generate a signal identifying the contact between the cutting knife of the rotary cutting head and the foreign body being in the material to be cut, based on the maximum value of the sensor signal.

[0016] The apparatus according to the invention is further characterised in that the signal analyzer is adapted to eliminate the interference from the environment based

on a signal coming from at least two sensors.

[0017] The object of the invention is also a method for detecting damage to the cutting knife in the cutting apparatus in the tobacco industry comprising steps wherein: detecting by means of at least one sensor the cutting apparatus vibration induced by the contact between the cutting knife of the rotary cutting head and the foreign body being in the material to be cut; characterised in that by means of the signal analyzer, based on detected vibration: determining a characteristic value of vibration; comparing value of vibration with at least one limit value; for the characteristic value of vibration higher than at least one limit value generating a signal identifying the contact between the cutting knife of the rotary cutting head and the foreign body being in the material to be cut.

[0018] The damage detection method according to the invention is further characterised in that the characteristic value of vibration is determined on the basis of the peak value of acceleration measured by at least one sensor.

[0019] The damage detection method according to the invention is further characterised in that the characteristic value of vibration is compared with two limit values and a first signal identifying the contact with the cutting knife of the rotary cutting head is generated when the characteristic value of vibration is greater than the first limit value, and a second signal identifying the contact with the cutting knife of the rotary cutting head is generated when the characteristic value of vibration is greater than the second limit value.

[0020] The damage detection method according to the invention is further characterised in that the vibration of the cutting apparatus is detected by means of at least two sensors.

[0021] The damage detection method according to the invention is further characterised in that the signal from at least two sensors is used to eliminate the influence of the environment on the detection of vibration of the cutting apparatus induced by the contact between the cutting knife of the rotary cutting head and the foreign body being in the material to be cut.

[0022] The damage detection method according to the invention is further characterised in that in response to the signal identifying the contact between the cutting knife of the rotary cutting head and the foreign body being in the material to be cut which is greater than the first limit value a warning signal informing the operator about the event is generated.

[0023] The damage detection method according to the invention is further characterised in that in response to the signal identifying the contact between the cutting knife of the rotary cutting head and the foreign body being in the material to be cut which is greater than the first limit value an actuating signal stopping the operation of the cutting apparatus is generated.

[0024] The damage detection method according to the invention is further characterised in that the limit values may be changed by the operator.

[0025] This invention solves the problem of detection of cutting knife damage caused by the contact with the foreign body being in the cut material, ensures a high quality of material cutting and reduces the amount of rejected material, thus decreases the production cost. Preferably it is possible to identify the cutting knife damage caused by the contact with the foreign body being in the cut material in the production environment in the presence of strong acoustic interference and mechanical vibration coming from the outside.

[0026] As a result of the invention it is possible to detect the knife damage occurring in consequence of the foreign body getting into the cut material during the cutting of a material of plant origin, and it is possible to obtain a finished product free of foreign bodies.

[0027] The object of the inventions was shown in detail in a preferred embodiment in a drawing in which:

Fig. 1 shows a cutting apparatus of the tobacco industry in a side view;

Fig. 2 shows a detailed view of a fragment of the cutting apparatus of the tobacco industry;

Fig. 3 shows an example signal sequence for the characteristic value and the limit values.

[0028] Fig. 1 shows a cutting apparatus 1 designed to cut materials of plant origin intended for smoking articles. The material 9 to be cut is fed through an inlet 2 onto a bottom conveyor 3a which works together with a conveyor 3b and conveys the material 9 towards a rotary cutting head 4. The conveyors 3a and 3b are situated convergently in order to increase the material 9 concentration in the conveying direction. At the common end of the conveyors 3a and 3b there is situated a bed knife unit 5 acting as a mouthpiece. The concentrated material passing through the bed knife unit 5 towards the rotary cutting head 4, for the time of cutting by cutting knives 6 situated on the circumference of the rotary cutting head 4, is momentarily held down by the bed knife unit 5 and cut, and then transferred further through a chute 7 in the form of cut material to a receiving apparatus. The material 9 to be cut ma contain undesired foreign bodies 8 which may damage the cutting knives 6. During a contact of the cutting knife 6 with the foreign body 8 the mechanical vibration is generated and recorded by at least one sensor 10. The most preferred location of the sensor is the area around the place of contact of the cutting knife 6 with the material 9. The sensor 10 may be situated in another part of the apparatus; however, there is a risk that the vibration occurring as a result of contact of the cutting knife 6 with the foreign body 8 will be smaller and unrecognizable against the background of vibration coming from the environment. By comparing the signal coming from one sensor 10 situated in the direct environment of the place of contact of the cutting knife 6 with the material 9 with the signal coming from the second sensor 10 situated in another part of the apparatus it is possible to eliminate

the noise caused by vibration coming from the environment or from other parts of the cutting apparatus 1.

[0029] An accelerometer, e.g. a piezoelectric, piezoresistive or capacitive accelerometer, ma be used as the sensor 10. The sensor 10 may use an electromechanical element. Preferably, the sensor 10 detects vibration in the range between 0.1 Hz and 5 kHz.

[0030] In the event of contact of the cutting knife 6 with the foreign body 8, in the bed knife unit 5 there will occur vibration which will be recorded by the sensor 10. The value of such vibration depends among others on the type of material of the foreign body 8, the type of material of the cutting knife 6, the rotational speed of the cutting head 4 and the type of the cut material 9. In the event of recording of vibration in the cutting apparatus 1 by at least one sensor 10 situated in the material 9 cutting area, the signal 11 is transmitted to at least one signal analyzer 20. Preferably, the sensor 10 may be situated on a side plate 12 of the cutting apparatus 1 in the area of the bed knife unit 5. The cutting apparatus 1 mechanical vibration monitoring system 15 consists of the sensors 10 connected to the signal analyzer 20. The signal analyzer 20 analyses the vibration detected by means of at least one sensor 10. The signal analyzer 20 may be e.g. a multichannel signal analyzer provided with an analogue-to-digital converter with a program-controlled sampling frequency up to 1 MHz, a set of analogue measuring amplifiers, filters and sample-and-hold systems. Based on the signal from at least one sensor 10, the signal analyzer 20 determines the characteristic value of vibration and compares it with at least one limit value, preferably with two limit values. The characteristic value of vibration may be determined on the basis of the peak value of vibration received directly, the parameters of the signal subjected to filtration, or another parameter of the signal coming from the sensor 10 or from more than one sensor 10. The characteristic value may be values measured directly or obtained on the basis of signal analysis in terms of both time and frequency. The limit values are set by the operator and are dependent e.g. on the type of cut material, the material humidity, the frequency of rotation of the rotary cutting head 4 and other external factors which may influence the vibration of the cutting apparatus 1. It is essential that the limit value is a value of the same kind as the characteristic value obtained on the basis of vibration i.e. that these are values expressed in the same units. In the monitoring system 15, there may be set several limit values 25, 26 upon exceeding of which a warning signal 35 and/or an actuating signal 45 will be generated. In addition, the monitoring system 15 may divide the period of one rotation of the rotary cutting head 4 into intervals corresponding to the material 9 cutting by each of the knives 6 situated on the circumference of the rotary cutting head 4. Then for each interval may be determined the characteristic value 14 of vibration based on the absolute maximum/peak vibration value which will be compared with the limit values 25, 26 set in the monitoring system 15.

[0031] According to the invention, the limit values 25, 26 may remain at a constant level, their settings may be done by the operator, may be also set adaptively in a control loop considering a gradual wear of the knives resulting from the normal cutting process. The limit values 25, 26 may be also determined on the basis of historical data aggregated globally (based on the operation history of a number of machines) or historical data aggregated locally (based on the operation history of a single machine) or a combination thereof.

[0032] If the characteristic value of vibration exceeds at least one limit value 25, 26 set in the monitoring system 15, the signal analyzer 20 will generate the warning signal 35 or the actuating signal 45. The monitoring system 15 may have two set limit values, the lower limit value 25 and the upper limit value 26. The lower limit value 25 is smaller than the upper limit value 26. The lower limit value 25 may be set so that exceeding it informs about a contact of the cutting knife 6 with the foreign body 8 which, however, does not damage the edge of the cutting knife 6. The upper limit value 26 may be set so that exceeding it informs about a contact of the cutting knife 6 with the foreign body 8 resulting in the damage to the edge of the cutting knife 6. In such case, in the system 15 there is generated the actuating signal 45 which may cause the switch-off of the cutting apparatus 1. After stopping the cutting apparatus 1, the operator may conduct a visual inspection of the cutting knives 6 and replace any damaged cutting knives 6.

[0033] Additionally, in the cutting apparatus 1 there may be used further means which are activated when the characteristic value of vibration 14 exceeds at least one limit value 25, 26. The means used may comprise the rejection of cut material for the purpose of additional checking for the presence of the foreign bodies 8 as well as the sharpening means 12 intended for the sharpening of the cutting knives 6, shown in Fig.2.

[0034] The characteristic value of vibration 14 may mean more than one characteristic value of vibration, in particular, but not exclusively, when the monitoring system 15 consists of more than one sensor 10. In this case, exceeding at least one limit value 25, 26 by any of the characteristic values of vibration 14 may generate the warning signal 35 or the actuating signal 45.

[0035] Fig. 2 shows a detailed view of a fragment of the cutting apparatus 1 according to the invention showing the rotary cutting head 4 with the cutting knives 6 during the material 9 cutting. The compressed material 9, transferred between the conveyors 3a and 3b towards the rotary cutting head 4, is held down during the cutting by the bed knife unit 5. The cutting knives 6 are situated on the circumference of the rotary cutting head 4 rotating around its own axis X situated principally perpendicular to the direction of feeding of the material 9 to be cut. During the cutting of the material 9 the cutting knives 6 pass the bed knife unit 5 from the conveyors 3a and 3b at a distance S which is principally smaller than 0.5 mm. In the preferred embodiment, the distance S is smaller

than 0.2 mm. With the cutting knives 6 being positioned in such a way relative to the bed knife unit 5, the smallest foreign body 8 being in the material 9 may cause damage to the knife 6 and getting of parts of a broken or chipped edge fragment of the cutting knife 6 into the cut material.

[0036] The method for detecting damage to the cutting knife in the cutting apparatus of the tobacco industry according to the invention comprises a separable step wherein the vibration of the cutting apparatus induced by the contact with the cutting knife of the rotary cutting head is detected. This step is accomplished by means of at least one sensor; in particular it is an accelerometer measuring the accelerations occurring in the metal structure of the cutting apparatus.

[0037] The next step of the method is to determine, based on the received signal, the characteristic value of vibration 14. As mentioned above, this value may be the recorded peak value of the signal of acceleration of the structure of the apparatus at the sensor fixing point. The values determined on the basis of such signal, e.g. the maximum deflection value, the mean value within a set period of time, the weighted mean value considering the weights reflecting the control model, may just as well be used as the characteristic value 14.

[0038] In the next step of the method according to the invention, the characteristic value of vibration 14 is compared with at least one limit value 25, 26. According to the invention, the limit values 25, 26 may remain at a constant level during the operation of the apparatus, their settings may be done by the operator during the operation of the apparatus based on his experience (heuristic control), or may be also done adaptively in a control loop considering the gradual knife wear resulting from the normal cutting process. The limit values 25, 26 may also be determined on the basis of historical data aggregated globally (based on the operation history of a number of machines) or historical data aggregated locally (based on the operation history of a single machine) or a combination thereof. The limit values 25, 26 may also be determined individually for particular knives (such control model considers differences in the quality of material of particular knives and their individual degree of wear).

[0039] Moreover, the characteristic values 14 and the limit values 25, 26 may be not only individual scalar values, but also characteristic patterns built in the space of multiple variables. The preferred embodiment of this step consists in analysing pairs or triplets of the characteristic values 14 coming from different sensors disposed at different points on the machine and, based on this, determining the multidimensional characteristic value of vibration allowing to determine e.g. the location of a vibration source or the properties of a foreign body with which the cutting knife has come into contact.

[0040] Then for the characteristic value of vibration 14 higher than at least one limit value 25, 26 the signal identifying the contact between the cutting knife of the rotary cutting head and the foreign body being in the material to be cut is generated.

[0041] However, the simplest way of embodiment of the method according to the invention is to use the characteristic value of vibration 14 determined on the basis of the maximum acceleration value, which was shown in detail in Fig.3 in the form of an example signal for the characteristic value and the limit values.

[0042] During the material 9 cutting by the cutting knives 6 situated on the rotary cutting head 4, the vibration received by the sensor 10 is generated and recorded in the form of the signal 11. The signal analyzer 20 uses the characteristic value of vibration 14 generated during the contact of the cutting knife 6 with the foreign body 8 and compares it with two limit values 25 and 26. Based on this comparison, the first signal identifying the contact with the cutting knife of the rotary cutting head is generated when the characteristic value of vibration is greater than the first limit value 25 and the second signal identifying the contact with the cutting knife of the rotary cutting head is generated when the characteristic value is greater than the second limit value 26. The vibration 16 values generated during the contact of the cutting knives 6 with the material 9 to be cut are disregarded.

[0043] Considerable advantages may also be achieved by using at least two sensors 10. The signal from at least two sensors 10 is used to eliminate, by means of damping, the environmental influence on the detection of vibration of the cutting apparatus 1 induced by the contact with the cutting knife 6 of the rotary cutting head 4.

[0044] A preferred embodiment of the method according to the invention is generating the signal informing the operator about the event in response to a signal identifying the contact between the cutting knife 6 of the rotary cutting head 4 and the foreign body 8 being in the material 9 to be cut. If the signal identifying the contact between the cutting knife 6 of the rotary cutting head 4 and the foreign body 8 being in the material 9 to be cut is greater than the second limit value 26, the signal stopping the operation of the apparatus is generated.

Claims

1. Cutting apparatus (1) of the tobacco industry comprising:

   a bearing frame;
   a rotary cutting head (4) provided with cutting knives (6) situated on the circumference of the rotary cutting head (4), with the cutting knives (6) being situated principally parallel to the axis of rotation (X) of the rotary cutting head (4);
   a feeding conveyor (3a, 3b) adapted to feed a material (9) to be cut to the rotary cutting head (4); and
   a bed knife unit (5) situated between the conveyor (3a, 3b) and the rotary cutting head (4);

characterised in that
the cutting apparatus (1) further has a cutting apparatus (1) mechanical vibration monitoring system (15) comprising at least one vibration sensor (10), the monitoring system (15) being built and adapted in such a way that it is possible to detect vibration induced by the contact between the cutting knife (6) of the rotary cutting head (4) and a foreign body (8) being in the material (9) to be cut, whereas the monitoring system (15) also comprises a signal analyzer (20) and is connected with the cutting apparatus (1) control system.

2. Cutting apparatus (1) as in claim 1 **characterised in that** the vibration sensor (10) is an accelerometer.

3. Cutting apparatus (1) as in claim 1 or 2 **characterised in that** the vibration sensor (10) has the operating frequency range between 0.3 Hz and 5 kHz.

4. Cutting apparatus (1) as in any of the claims 1 to 3 **characterised in that** at least one first vibration sensor (10) is situated in the area of the bed knife unit (5).

5. Cutting apparatus (1) as in any of the claims 1 to 4 **characterised by** comprising at least one second vibration sensor (10) situated outside the area of the bed knife unit (5).

6. Cutting apparatus (1) as in any of the claims 1 to 5 **characterised in that** the signal analyzer (20) is adapted to generate a signal identifying the contact between the cutting knife (6) of the rotary cutting head (4) and the foreign body (8) being in the material (9) to be cut, based on the maximum value of the sensor (10) signal.

7. Cutting apparatus (1) as in any of the claims 5 to 6 **characterised in that** the signal analyzer (20) is adapted to eliminate the interference from the environment based on a signal coming from at least two sensors (10).

8. Method of detecting damage to the cutting knife (6) in the cutting apparatus (1) in the tobacco industry comprising steps wherein:

detecting by means of at least one sensor (10) the cutting apparatus (1) vibration induced by the contact between the cutting knife (6) of the rotary cutting head (4) and the foreign body (8) being in the material to be cut;
characterised in that by means of the signal analyzer (20), based on detected vibration:

determining a characteristic value of vibration;
comparing the characteristic value of vibration with at least one limit value;
for the characteristic value of vibration higher than at least one limit value generating a signal identifying the contact between the cutting knife (6) of the rotary cutting head (4) and the foreign body (8) being in the material (9) to be cut.

9. Damage detection method as in claim 8 **characterised in that** the characteristic value of vibration is determined on the basis of the peak value of acceleration measured by at least one sensor (10).

10. Damage detection method as in any of the claims 8 to 9 **characterised in that** the characteristic value of vibration is compared with two limit values and a first signal identifying the contact with the cutting knife (6) of the rotary cutting head (4) is generated when the characteristic value of vibration is greater than the first limit value, and a second signal identifying the contact with the cutting knife (6) of the rotary cutting head (4) is generated when the characteristic value is greater than the second limit value.

11. Damage detection method as in any of the claims 8 to 10 **characterised in that** the vibration of the cutting apparatus (1) is detected by means of at least two sensors (10).

12. Damage detection method as in claim 11 **characterised in that** the signal from at least two sensors (10) is used to eliminate the influence of the environment on the detection of vibration of the cutting apparatus (1) induced by the contact between the cutting knife (6) of the rotary cutting head (4) and the foreign body (8) being in the material to be cut.

13. Damage detection method as in any of the claims 8 to 12 **characterised in that** in response to the signal identifying the contact between the cutting knife (6) of the rotary cutting head (4) and the foreign body (8) being in the material (9) to be cut which is greater than the first limit value a warning signal (35) informing the operator about the event is generated.

14. Damage detection method as in any of the claims 8 to 13 **characterised in that** in response to the signal identifying the contact between the cutting knife (6) of the rotary cutting head (4) and the foreign body (8) being in the material (9) to be cut which is greater than the first limit value an actuating signal (45) stopping the operation of the cutting apparatus (1) is generated.

15. Damage detection method as in any of the claims 8 to 14 **characterised in that** the limit values may be changed by the operator.

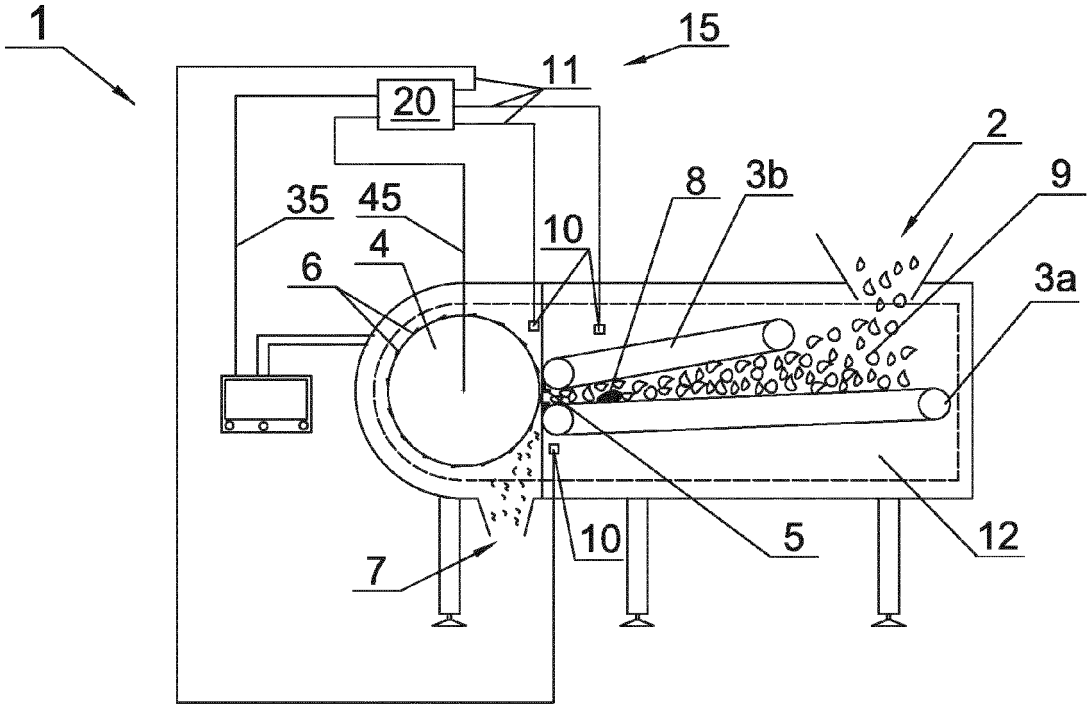


Fig. 1

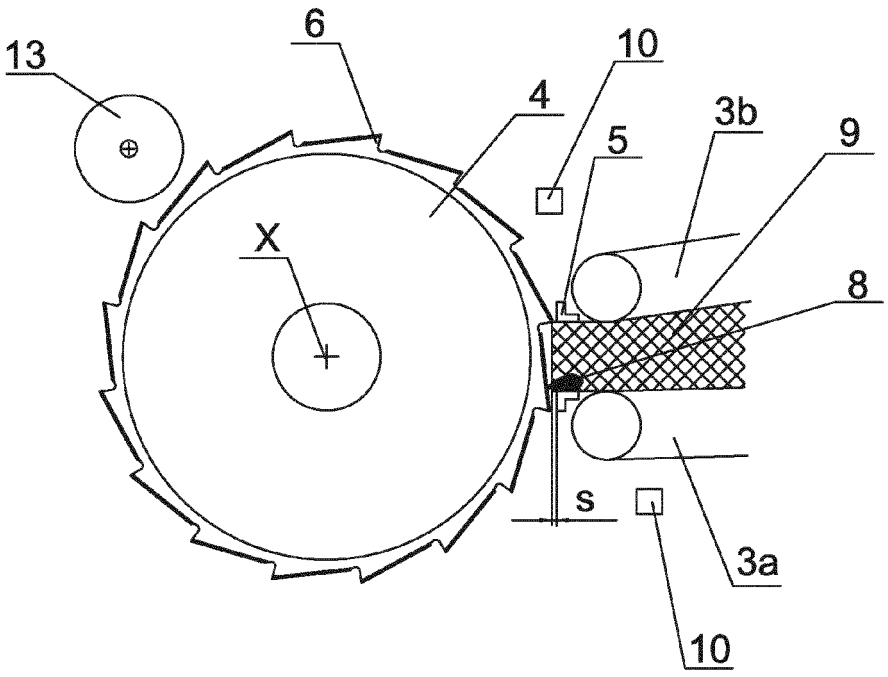


Fig. 2

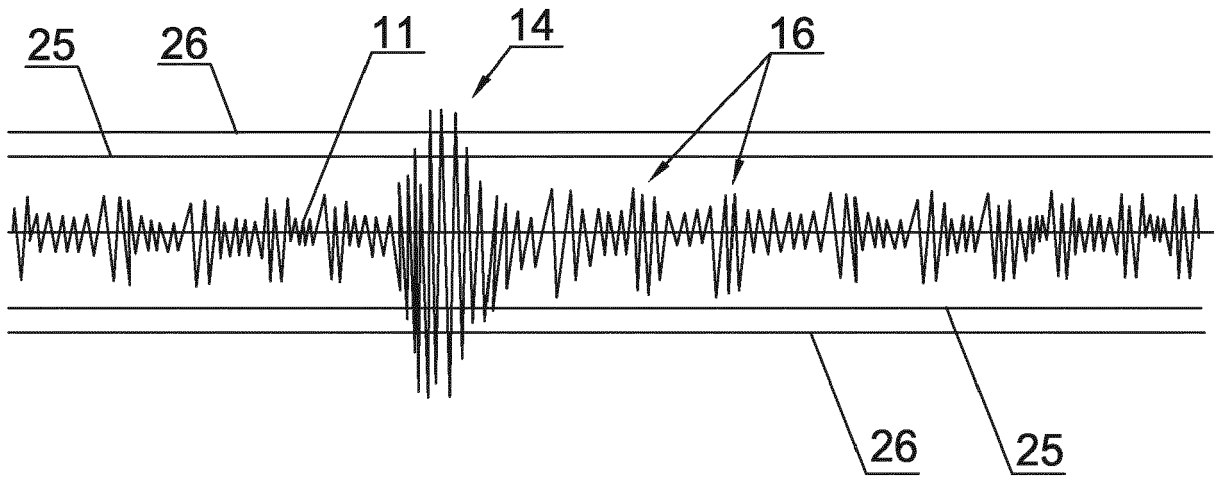


Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 18 15 3598

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	US 2 714 410 A (GEORGE MOLLER) 2 August 1955 (1955-08-02) * column 1, line 15 - line 42; figures 1-4 *	1-15	
A	US 4 636 779 A (THOMAS CHARLES E [US] ET AL) 13 January 1987 (1987-01-13) * column 2, line 35 - column 3, line 40 * * column 4, line 60 - column 5, line 52; figures 1-8 *	1-15	
A	US 2014/202126 A1 (DEPESTEL BERNARD E D [BE] ET AL) 24 July 2014 (2014-07-24) * paragraph [0010] - paragraph [0019] *	1-15	TECHNICAL FIELDS SEARCHED (IPC) A24B B26D G05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 April 2018	Espla, Alexandre

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 15 3598

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- DE 10021614 **[0007]**
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