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(58) Field of search
UK CL (Edition J) **G1N NACD NAFC NAFD NAFE, G1R RBE**
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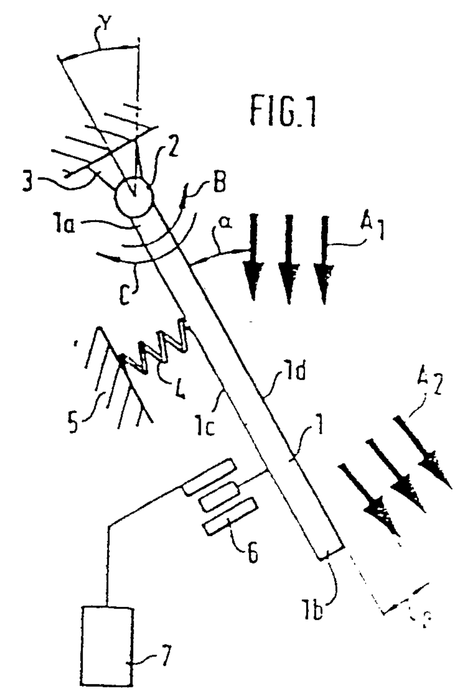
(54) **Monitoring a fibre-flock stream**

(57) The amount of fibre-flocks in flight in spinning preparation, for example in a pneumatic conveyor line, is monitored by causing the flock to impact against an impact element 1, and measuring the loading or deflection of the element. The loading may be determined by a load cell or, as shown by a restoring spring 4 and an inductive movement sensor 6.

The impact element is preferably inclined to the flight paths of the flocks so that the flocks are deflected and may contain slots of smaller width than the flock size. The output signal from the impact element may be integrated and air flow rate may also be measured.

FIG.1



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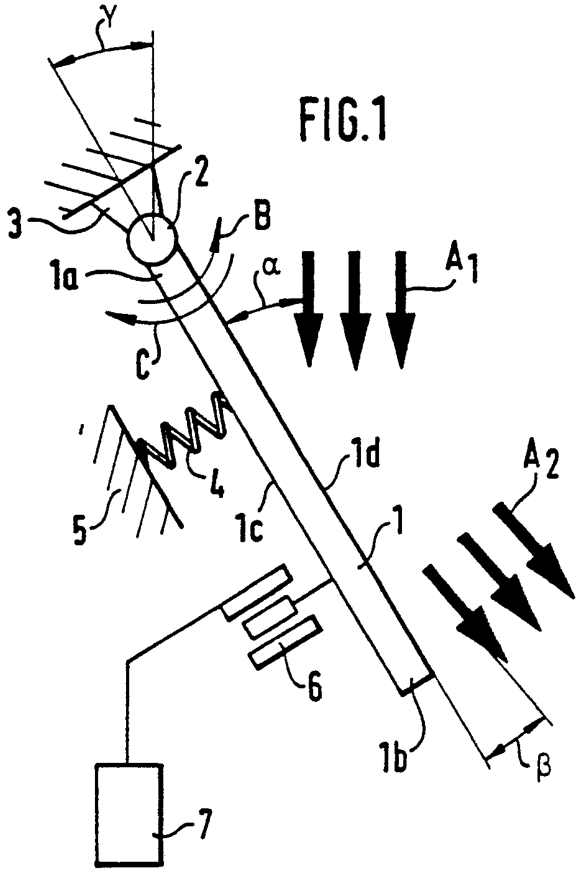


FIG.1

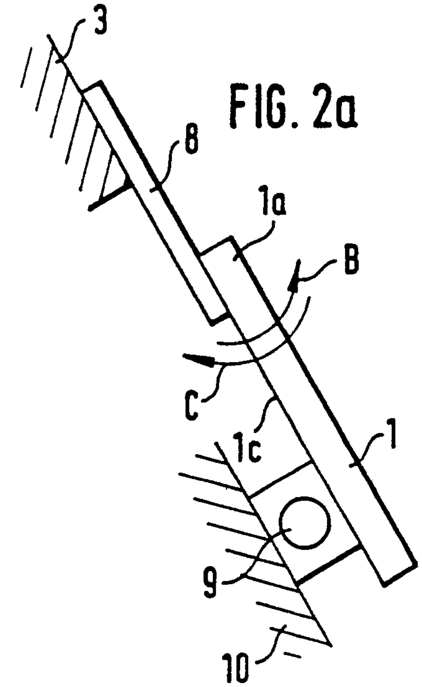


FIG. 2a

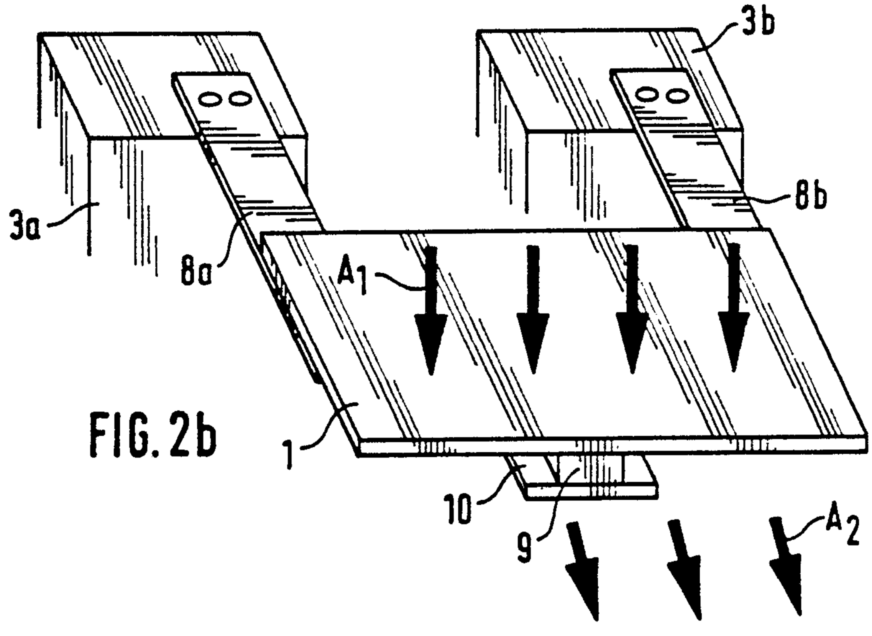


FIG. 2b

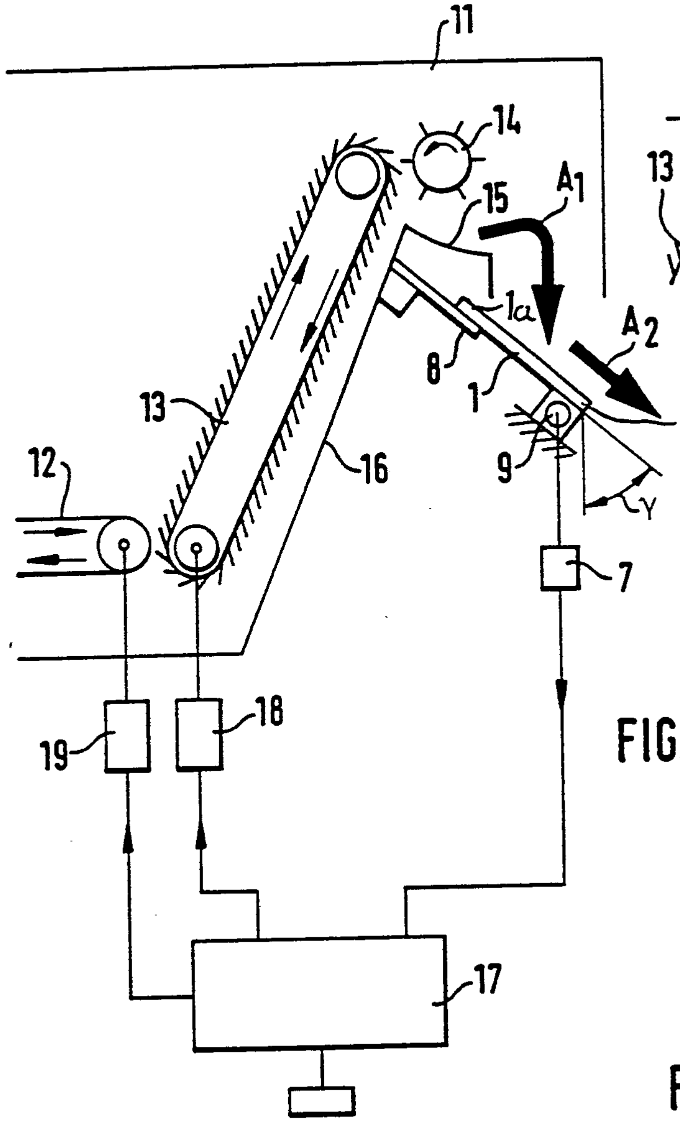


FIG. 3a

FIG. 3b

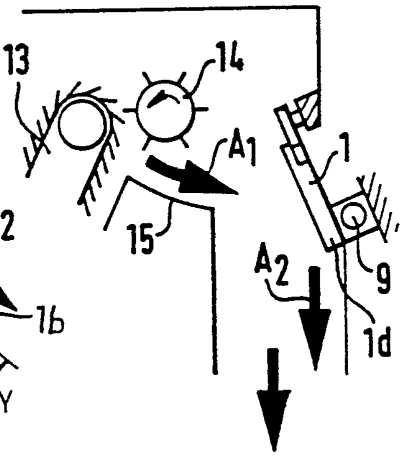


FIG. 4b

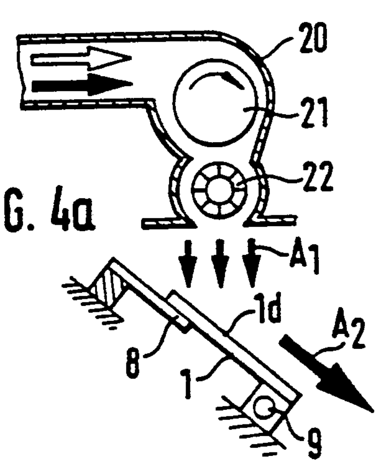


FIG. 4a

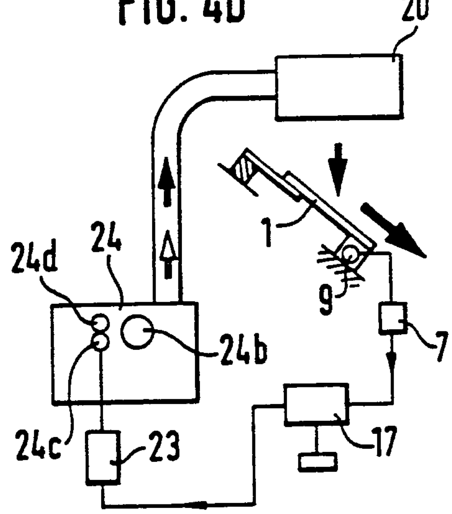
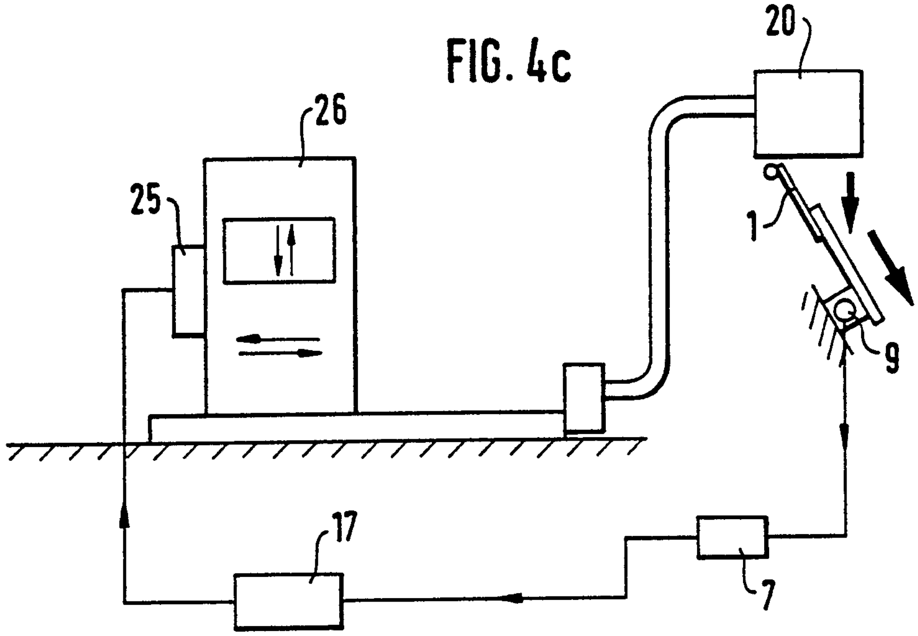


FIG. 4c



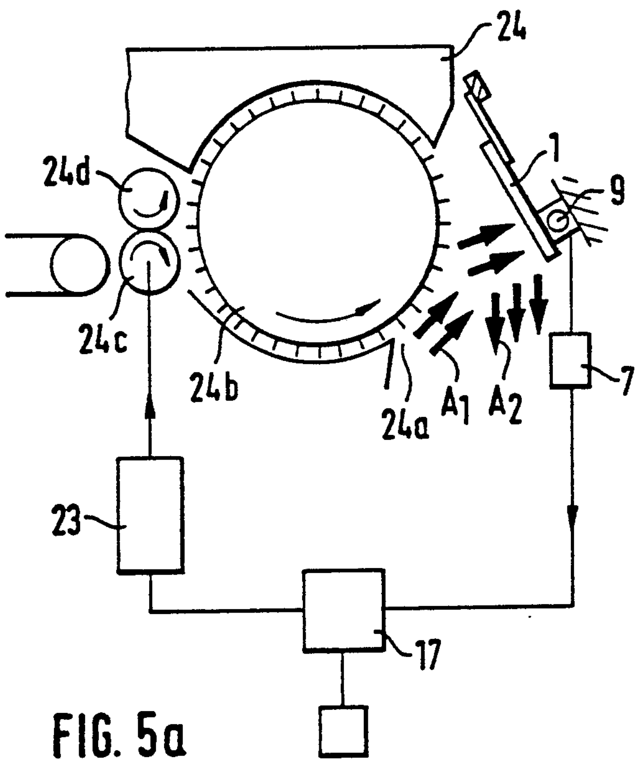


FIG. 5a

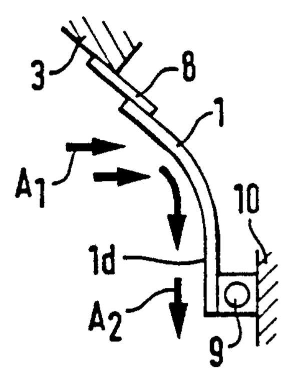


FIG. 5b

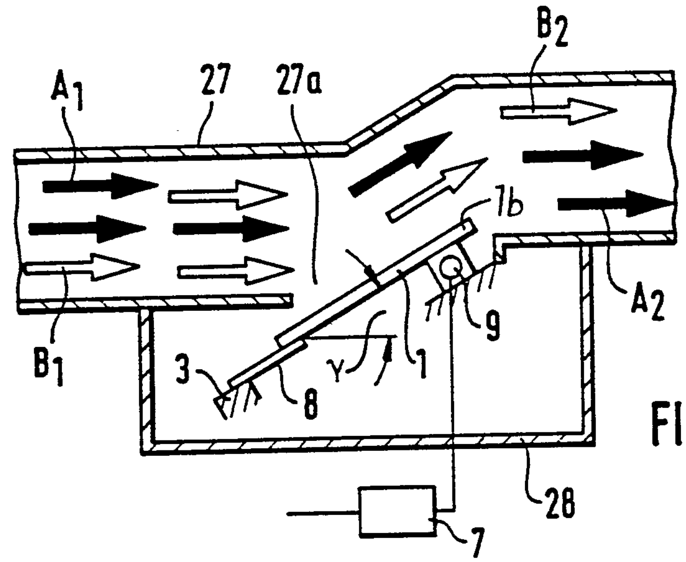


FIG. 6

FIG. 7a

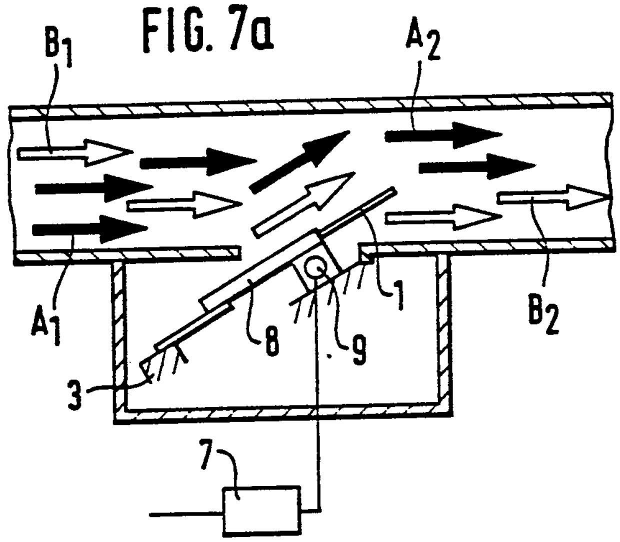


FIG. 7b

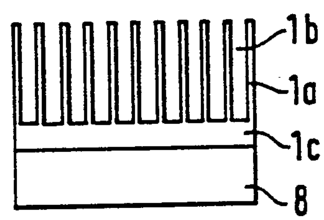


FIG. 8

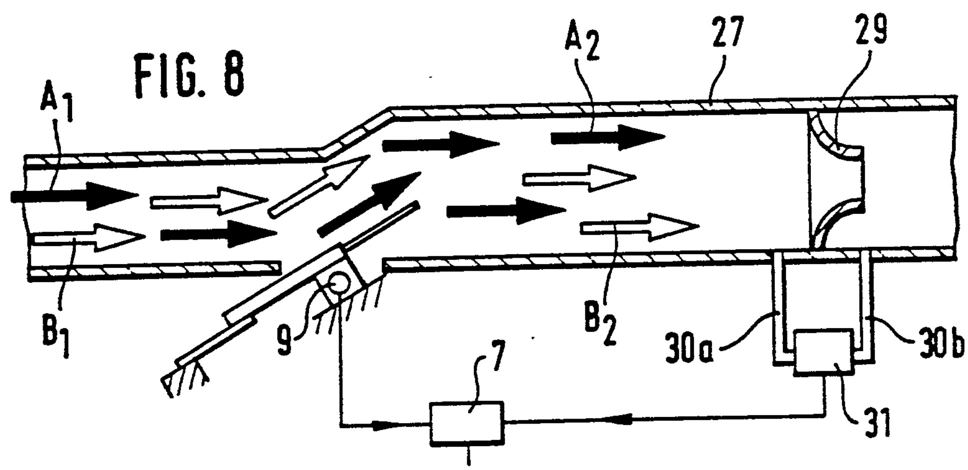


FIG. 9

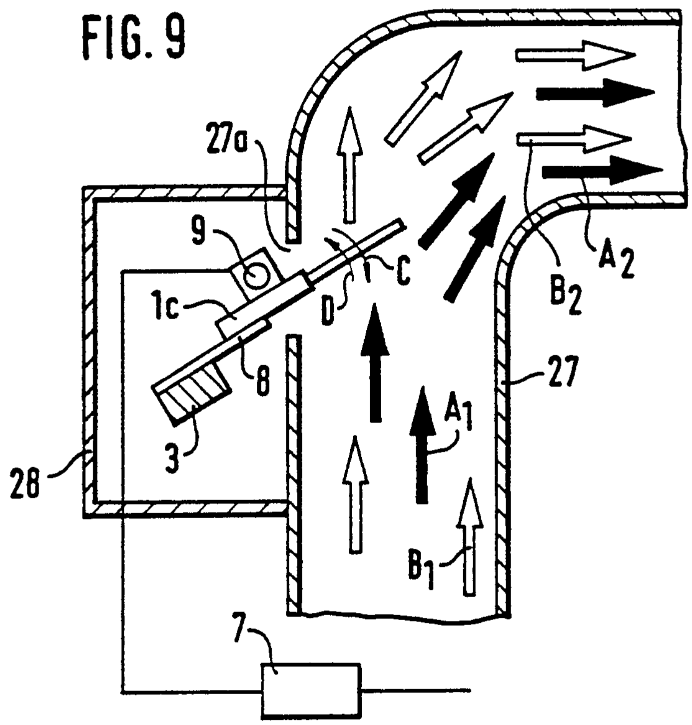
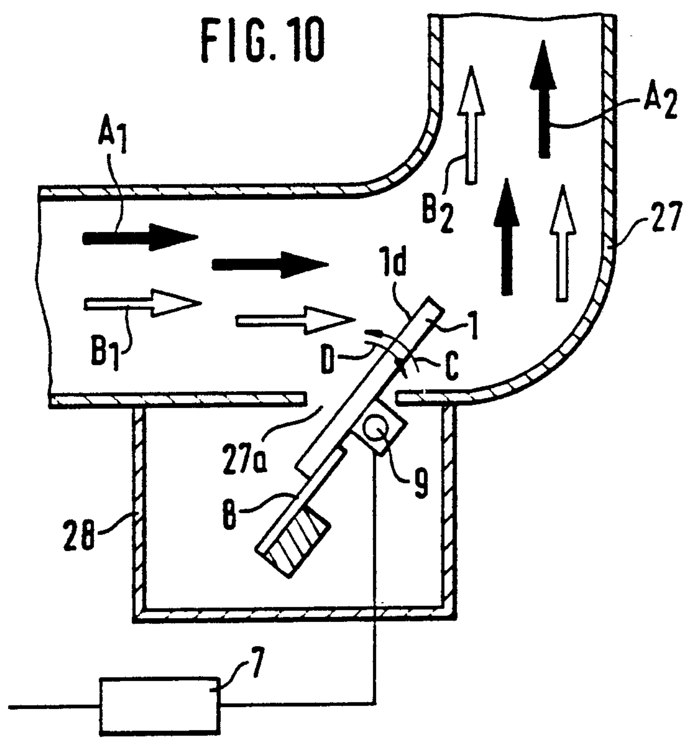


FIG. 10



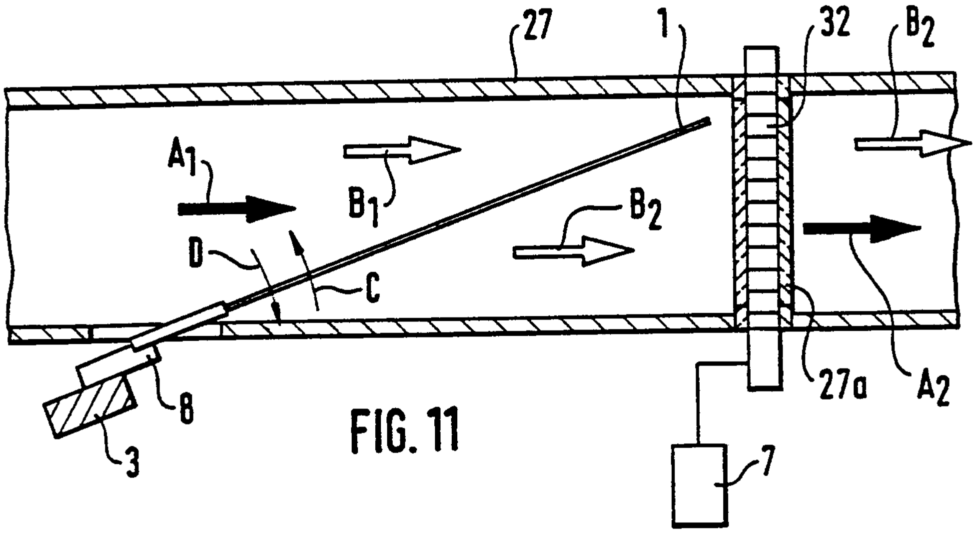


FIG. 11

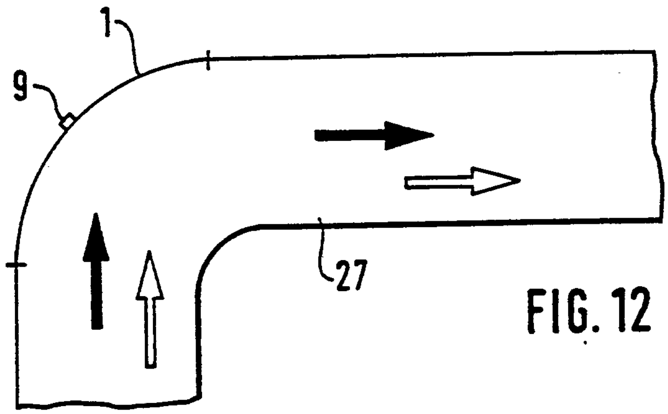


FIG. 12

FIG. 13a

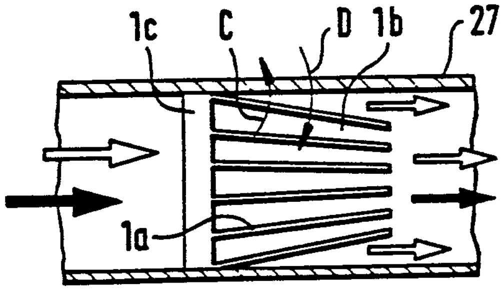
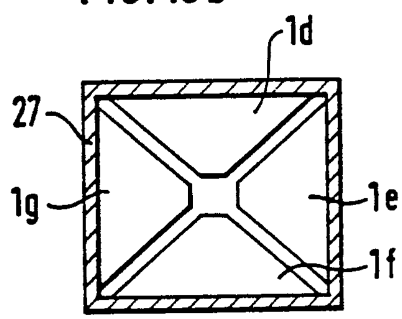


FIG. 13b



Method and apparatus for monitoring a fibre-flock stream

The invention relates to a method and apparatus for monitoring a stream of fibre-flocks in flight in spinning preparation, for example in a pneumatic conveyor line.

In order to control the flow of fibre material in a textile machine, sensors that determine the throughput and regulating members that alter the throughput are required. In a known method conveyor-type weighers or weighing plates are used as sensors for determining the throughput. Variable-speed geared motors that drive transport rollers for the material transport are used as regulating members. Those sensors are not, however, suitable for regulating sites of certain machines and installations since they cannot measure flocks in flight. Furthermore, for space reasons it is often not possible to use weighing systems. In a different method according to another proposal, sensors that scan flocks in flight optically (light barriers) are used, and the throughput is calculated using an electronic evaluating means. That system has proved disadvantageous since there are no clear correlations that are sufficiently analogous to the throughput. In a further proposed method an attempt was made to monitor the stream of conveying air by means of pressure measurement and to arrive at the amount of material throughput from the changes in pressure and air speed resulting from the material loading of that stream.

That system also proved unsatisfactory in practice. Yet another proposal involved diverting streams of flocks from material ducts periodically using dividers, separating off those streams and weighing them. The weight was then ascertained during an observation period. On the assumption that the stream of material changes little with time the throughput was then also determined over a longer period. That method proved inaccurate and unsuitable for machine control, which is intended to effect trouble-free operation. All the mentioned proposals have in particular the disadvantages that they do not allow accurate measurement of the stream of fibre flocks over a specific period and cannot be used everywhere that fibre-flock streams are in flight in spinning-preparation machines and installations.

It is an object of the invention to provide a method for measuring the amount of fibre-flocks in flight, that avoids or mitigates the mentioned disadvantages and that, especially, allows more accurate measurement of the fibre-flock stream and makes it possible for the measurement to be carried out at most or all of the sites where the fibre-flock stream occurs inside a spinning-preparation machine or installation.

According to the invention there is provided a method for measuring the amount of a stream of fibre-flocks in flight in spinning preparation, for example in a pneumatic conveyor line, in which the stream of fibres passes a measuring site having a measuring element and in which measured values are supplied to an electronic evaluating device, the amount of the fibre-flock stream being regulated or controlled, characterised in that the fibres come up against one side of an impact element the loading or deflection of which is measured and that the fibres are deflected by the same side of the impact element.

The impact of the fibres on the impact element is measured and recorded. The measurement by means of impact can take place at any site at which the fibre flocks are in flight. The streams of flocks can be measured in pipelines. In accordance with an especial advantage of the method of the invention it can also detect fibre flocks when they are falling freely or are in free flight. The loading or deflection of the impact element is measured, for example integrated over a certain period, the measured value being used in combination with regulating or control devices and regulating members in machines to influence fibre-material throughput in a specific manner.

The invention also includes an advantageous apparatus for carrying out the method in which the measuring element is an impact element with which an element for measuring the loading or deflection is associated and which is inclined at an angle (α) in the direction of the fibre-flock stream. A type of impact balance is thus used as the sensor system. The flock stream is deflected at an angle onto a detector plate. This detector plate deflects the fibre-material stream. What may be described as an input pulse (a pulse being a force applied for a short period of time) acts on the plate as a result of the momentum of a flock meeting the plate and what may be described as an output pulse acts on the plate as a result of the momentum of a flock leaving the plate. The combined effect of the input and output pulses give rise to a measurable force on the plate.

The measured variable is dependent upon (and may be proportional to) the pulse difference. The pulse difference is arrived at by vectorial subtraction of the outgoing pulse from the incoming pulse. The size of each pulse is dependent upon the product m x v, the vertical velocity (v) of the flocks playing a part here as well as the mass (m). The velocity of the flocks is dependent on the air speed. The air flow, moreover, itself has an influence on the force applied to the impact element. In order to reduce its effect it can be measured, either upstream or downstream of the measurement site for the material throughput. The result of the air-speed measurement - an indirect variable, such as air throughput can alternatively be used - can be included in the evaluation of the measured value and processed in order to adjust it to reduce or eliminate the effect of changing air speed. The impact element may be an impact sheet, a measuring plate or the like. The impact element is preferably a comb having narrow slots the width of which is smaller than the flock size. The impact element is advantageously mounted at one end and free at the other end. The impact element is preferably secured to at least one leaf spring at one end. The impact element is advantageously secured at one end in a hinge. The impact element is preferably spring-loaded. The element for measuring the loading or deflection is advantageously arranged on the side of the impact element that is remote from the fibre-flock stream. The element for measuring the loading or deflection may be a load cell or an inductive movement recorder. The evaluating device preferably has an integrating device by means of which the amount of flocks in a specific unit of time is determined. There is advantageously a measuring device for the amount of air or the air speed, which is connected to the evaluating device. There is preferably arranged downstream of the evaluating device a regulating and control device that is connected to a speed-variable drive motor of a flock-conveying device. The amount supplied is influenced as a function of the measurement signal. That can be effected by altering the drive speed for a flock-feeding device, for example feed rollers, spiked feed lattices or the like. Desired throughputs can be fed in a desired-value setter. The impact element is advantageously arranged inside the pneumatic fibre-conveying line. The impact element may form part of the wall of the fibre-flock-conveying line. The impact element may be arranged downstream of a fibre-supplying device. The fibres may strike the impact element when falling freely.

The present invention further provides a method of measuring the amount of fibre flocks in a stream of flocks that are in flight during a spinning preparation process, wherein flocks are caused to impact against an impact element and a signal representative of the force of the flocks on the impact element is generated as an output signal.

The present invention still further provides an apparatus for measuring the amount of fibre flocks in a stream of flocks that are in flight during a spinning preparation process, the apparatus including an impact element projecting into the flight path of the flocks and a sensor providing an output signal representative of the force of the flocks on the impact element.

By way of example, certain embodiments of the invention will now be described with reference to the accompanying diagrammatic drawings, of which:

Fig. 1 is a side view of an apparatus for monitoring a fibre flock stream, the apparatus including a compression spring and an inductive movement recorder,

Fig. 2a is a side view of an apparatus similar to Fig. 1 but including a leaf spring and load cell,

Fig. 2b is a perspective view of the apparatus according to Fig. 2a,

Fig. 3a shows an apparatus embodying the invention in a hopper feeder with a spiked feed lattice, downstream of which are freely falling fibre flocks,

Fig. 3b shows an apparatus embodying the invention in a hopper feeder with a spiked feed lattice, downstream of which there are fibre flocks in free flight,

Fig. 4a shows an apparatus embodying the invention underneath a condenser with freely falling fibre flocks,

Fig. 4b shows an apparatus as in Fig. 4a, with a connection by way of a regulating device to an upstream cleaner,

Fig. 4c shows an apparatus as in Fig. 4a, with a connection by way of a regulating device to an upstream bale opener,

Fig. 5a shows an apparatus embodying the invention connected downstream of a cleaner with fibre flocks in free flight and a flat impact element,

Fig. 5b shows an apparatus according to Fig. 5a, but with a curved impact element,

Fig. 6 shows an apparatus embodying the invention in a fibre-flock-conveying line and an impact element with a continuous (unbroken) impact surface,

Fig. 7a shows an apparatus embodying the invention in a fibre-flock-conveying line similar to Fig. 6 but with an impact element in the form of a comb,

Fig. 7b is a plan view of the comb-like impact element according to Fig. 7a,

Fig. 8 shows an apparatus according to Fig. 6 or 7a but with the addition of throughput-rate measurement,

Fig. 9 shows an apparatus embodying the invention in a fibre-flock-conveying line with the apparatus in a vertical portion of the line preceding a horizontal portion,

Fig. 10 shows an apparatus embodying the invention in a fibre-flock-conveying line but with the apparatus in a horizontal portion of the line preceding a vertical portion,

Fig. 11 shows an apparatus embodying the invention and including an optical indicating device,

Fig. 12 shows an apparatus embodying the invention having an elastomeric impact element as part of the wall of a flock-conveying-line,

Fig. 13a is a side view of an apparatus embodying the invention having a plurality of resilient impact elements, which are secured at one end in the shape of a ring, and which are in a fibre-flock-conveying line, and

Fig. 13b is a plan view of an apparatus embodying the invention having four impact elements projecting into the interior of a fibre-flock-conveying line.

In the various embodiments corresponding parts are generally given the same reference numerals.

Fig. 1 shows an impact element 1 in the form of a measuring plate, that is mounted at one end 1a on a hinge 2 which is attached to a fixed support 3. The other end 1b of the impact element 1 is free. The impact element 1 is inclined obliquely downwards at an angle (γ). Associated with the side 1c is a compression spring 4 which is supported on a fixed support 5. Also associated with the side 1c is an inductive movement recorder 6 (movement sensor) that is connected to an electronic evaluating unit 7. A fibre-flock stream A_1 (solid arrows) strikes the side 1d of the impact element from above at an angle α, for example approximately from 20 to 80°, and is deflected by the same side 1d of the impact element 1 at an angle β as fibre-flock stream A_2. The impact causes the impact element 1 to be deflected against the spring 4 in the direction of the curved arrow C; this deflection is detected by the movement sensor 6 and a corresponding electrical signal is transmitted to the evaluating unit 7. After the impact the impact element 1 is pivoted back in the direction of the arrow B by the restoring force of the spring 4.

In the embodiment shown in Fig. 2a the impact element 1 is connected at its end 1a by way of a leaf spring 8, serving as a holding, steering and guiding element, to the fixed support 3. Associated with the side 1c is a load cell 9 (force-measuring element) which is supported on a fixed site 10. In the load cell 9 are expansion measuring strips (EMS). Fig. 2b shows the perspective view according to Fig. 2a showing the flock streams A_1 and A_2 flying in and away, respectively. The flock streams are in the same directions relative to the element 1 as in Fig. 1.

Fig. 3a shows a hopper feeder 11 which in most respects is conventional having a feed lattice 12, a spiked feed lattice 13 and a stripper roller 14. Underneath the stripper roller 14 is a curved guide sheet 5 for conveying the stripped fibre flocks. The guide sheet is secured to a side wall 16. One end 1a of the impact element 1 is also secured to the side wall 16, by way of the leaf spring 8, in such a manner that the other end 1b projects freely beyond the guide sheet 15 obliquely downwards at an angle γ. The load cell 9 (force recorder) is connected by way of the evaluating device 7, which generates a mean value or forms an integral of the signal, to a control and regulating device 17 downstream of which an adjustable drive device 18 for the spiked feed lattice 13 and an adjustable drive device 19 for the feed lattice 12 are arranged. Falling freely, the fibre-flock stream A_1 strikes the impact element 1 from above and is deflected obliquely downwards from there as fibre-flock stream A_2. When the impact force is low the angle β that the stream A_2 makes with the element 1 may be zero or virtually zero.

In the modification of the embodiment of Fig. 3a that is shown in Fig. 3b the impact element 1 is arranged laterally in relation to the guide sheet 15. In free flight, the fibre-flock stream A_1 strikes the side 1d of the impact element 1, which is inclined at an angle γ, approximately horizontally, and from there falls vertically downwards as fibre-flock stream A_2.

Fig. 4a shows a known condenser 20 having a rotary screen drum 21 and a fan roller 22. Underneath the fan roller 22 the impact element 1 is arranged so that it is inclined obliquely downwards at an angle. The fibre-flock stream A_1 falls freely onto the side 1d. As shown in Fig. 4b, the output of the load cell 9, is connected via an evaluating device 7 and a control and regulating device 17 to an adjustable drive device 23, for example an electric motor, which drives the take-in roller 24c of an opening and cleaning machine 24, for example of the kind sold by Trützschler GmbH & Co. KG as the Trützschler RSK.

Fig. 4c shows an arrangement as in Fig. 4b, but in which the control and regulating device 17 is connected to the adjustable drive motor 25 for a bale opener 26, for example of the kind sold by Trützschler GmbH & Co. KG as the Trützschler BLENDOMAT BDT. The bale opener 26 is positioned upstream of the condenser 20.

In the embodiment of Fig. 5a a saw-toothed cleaner, for example of the kind sold by Trützschler GmbH & Co. KG as a Trützschler RSK, is provided. In the housing of the cleaner there is an opening 24a for the discharge of the fibre flocks flung off by a saw-toothed roller 24b. Arranged opposite the opening 24a and inclined at an angle is the impact element.

In a modification to the arrangement of Fig. 5a shown in Fig. 5b, the impact element is in the form of a curved or arched measuring plate, the fibre-flock stream A_1 striking the concave inside surface 1d.

Fig. 6 shows a horizontal fibre-flock-conveying line 27, for example a pipeline, for the pneumatic conveying of fibre flocks, by a fibre-material transport fan (not shown). The lower region of the fibre-flock-conveying line 27 has a wall opening 27a in which there is mounted, in a box 28, the impact element 1. The impact element 1 is inclined at an angle with respect to the horizontal fibre-flock-conveying line. The fixed support 3 and the leaf spring 8 are arranged in the box 28, while the impact element 1 projects as far as its free end 1b into the interior of the fibre-flock-conveying line 27. The flowing mixture of fibre flocks A_1 and air B_1 (unshaded arrows) strikes the side 1d of the impact element 1 and is deflected therefrom in the form of a mixture of fibre flocks A_2 and air B_2.

Although in the earlier drawings air flow is not shown, it will be understood that even in those cases there will be an air flow entrained with the flow of fibre flocks but that is different from the arrangement of Fig. 6 and subsequent drawings where the air flow is the means of conveying the flocks.

In a modified version of the arrangement of Fig. 6 shown in Fig. 7a the impact element 1 is in the form of a comb which is shown in Fig. 7b in plan view. Between the teeth 1a of the comb are narrow slots 1b the width of which is smaller than the flock size, with the result that the flocks are held back by the teeth 1a while the conveying air passes through the slots 1b. The teeth 1a are secured at one end in a holder 1c which is attached to the leaf spring 8. The load cell 9 is arranged underneath the holder 1c.

In accordance with a further modification shown in Fig. 8 a funnel 29 is arranged downstream of the comb-like impact element 1, inside the fibre-flock-conveying line 27, air conduits 30a and 30b being connected upstream and downstream of the nozzle 29 through openings in the wall of the conveying line and being connected to a device 31 for measuring the rate of air flow through the line 27. Like the load cell 9, the device 31 is also connected to the evaluating device 7.

Fig. 9 shows a pipeline 27 with a bend. In a wall of a vertically rising region of the pipeline 27 is an opening 27a through which the comb-like impact element 1 passes, the holder 1c, the leaf spring 8, the fixed support 3 and the load cell 9 being arranged in the box 28 outside the pipeline 27, and the teeth 1a of the comb-like impact element 1 being arranged obliquely upwards inside the pipeline 27. Directed vertically upwards is a stream of fibre flocks A_1 and air B_1. The teeth 1a of the comb 1 deflect the fibre flocks A_1 in the direction towards the horizontal portion of the pipeline 27, while the air B_1 passes through the gaps 1b. In the horizontal portion is the combined stream of flocks A_2 and air B_2. When the flocks A_1 come up against the teeth 1a, the comb-like impact element 1 is deflected in the direction of the arrow D, causing the load cell 9 to pick up a force that is passed on in the form of an electrical pulse to the evaluating device 7.

According to Fig. 10 the impact element 1 projects upwards through the opening 27a at an oblique angle into the horizontal portion of the pipeline 27. The stream of flocks A_1 and air B_1 strikes the surface 1b and is deflected by the oblique surface in the direction towards the vertical portion of the pipeline 27. As a result of the impact the spring-loaded impact element 1 is loaded in the direction of the arrow D.

In the embodiment shown in Fig. 11 the impact element 1 extends obliquely from the lower wall almost as far as the upper wall of the pipeline 27. In the region of the free end 1b of the element 1 there is a transparent region 27a, of, for example, plexiglass or the like, in the wall of the pipeline 27, with which region an optical device 32 comprising a row of adjacent light cells 32a.....32n or the like, which are connected to the evaluating device 7, is associated. As a result of the impact of the fibre flocks A_1 the comb-like impact element 1 is deflected in the direction of the arrow D. The altering of the position of the impact element 1 relative to the light cells 32a.....32n is detected by the light cells whose outputs are connected to the evaluating device 7. In addition the shadowing effect on the light cells 32a.....32n between the comb-like impact element 1 and the upper region of the pipeline 27, caused by the fibre flocks A_1 as they fly past, can be picked up.

Fig. 12 shows a pipeline 27 having a bend in which the wall of the pipeline in the outer region of the bend is of a deformable material, for example rubber. That region defines the impact element 1 which is thus a part of the wall of the pipeline. On the outside of the deformable wall there is at least one sensor 9 that detects the deflection or loading of the impact element 1. The sensor 9 is connected to the evaluating device 7.

In the embodiment shown in Fig. 13a a plurality of comb elements 1a arranged approximately in the form of a truncated cone are provided inside the pipeline 27 which is of approximately circular cross-section. The tooth-like elements 1a are secured at one end to the retaining element 1c. The teeth 1a, between which there are slots 1b, are inclined at an angle in the direction towards the central axis of the pipeline 27, with the result that the inlet cross-section of the truncated-cone-shaped impact element 1 is greater than the outlet cross-section. In Fig. 13b a modified form of impact element 1 is shown. The element 1 comprises four plates 1d to 1g, which are secured at one end in such a manner as to be pivotable, which may have openings for the passage of air, such as slots or the like, and which are arranged inside a pipe 27 of square cross-section and inclined in the direction of the fibre/air stream. The four plates 1d to 1g are approximately in the shape of a truncated pyramid. The deflection or force-loading of the teeth 1a or of the plates 1d to 1g is measured using a load cell or an inductive movement recorder and supplied to an evaluating device 7 (not shown).

It should be understood that features described above with reference to one embodiment may be incorporated, where appropriate, in another embodiment. For example, an air flow measuring arrangement such as that shown in Fig. 8 may be incorporated in any of the embodiments of Figs. 9 to 13b.

Claims:

1. A method of measuring the amount of fibre flocks in a stream of flocks that are in flight during a spinning preparation process, wherein flocks are caused to impact against an impact element and a signal representative of the force of the flocks on the impact element is generated as an output signal.

2. An apparatus for measuring the amount of fibre flocks in a stream of flocks that are in flight during a spinning preparation process, the apparatus including an impact element projecting into the flight path of the flocks and a sensor providing an output signal representative of the force of the flocks on the impact element.

3. An apparatus according to claim 2 in which an electronic evaluating device is connected to the sensor.

4. An apparatus according to claim 2 or 3 in which the impact element has an impact face inclined obliquely to the flight path of the flocks.

5. An apparatus according to any one of claims 2 to 4, in which the impact element has a substantially closed impact face projecting into the flight path of the flocks.

6. An apparatus according to any one of claims 2 to 4, in which the impact element has narrow slots the width of which is smaller than the flock size.

7. An apparatus according to any one of claims 2 to 6, in which the impact element is mounted at one end

such as to allow at least limited movement at the other end.

8. An apparatus according to any one of claims 2 to 7, in which the impact element is secured to at least one leaf spring.

9. An apparatus according to any one of claims 2 to 8, in which the impact element is secured at one end in a hinge.

10. An apparatus according to any one of claims 2 to 9, in which the impact element is spring-loaded.

11. An apparatus according to any one of claims 2 to 10, in which the sensor is arranged on a side of the impact element that is remote from the face against which fibre-flocks impact.

12. An apparatus according to any one of claims 2 to 11, in which the sensor is a load cell.

13. An apparatus according to any one of claims 2 to 12, in which the sensor is an inductive movement recorder for sensing movement of the impact element.

14. An apparatus according to any one of claims 2 to 13, in which an integrated device is provided downstream of the sensor for integrating the output signal over a specific unit of time.

15. An apparatus according to claim 3 or any one of claims 4 to 14 when dependent upon claim 3, in which there is provided a measuring device for measuring the amount or speed of the air along the flock flight path,

which measuring device is connected to the evaluating device.

16. An apparatus according to any one of claims 2 to 15, in which arranged downstream of the sensor is a regulating and control device which is connected to a flock feed device upstream along the flock path of the impact element.

17. An apparatus according to claim 16, in which the regulating and control device is connected to a speed-variable drive motor of a flock conveying device.

18. An apparatus according to any one of claims 2 to 17, in which the impact element is arranged inside a pneumatic fibre-conveying line.

19. An apparatus according to claim 18, in which the impact element is part of the wall of the fibre-conveying line.

20. An apparatus according to any one of claims 1 to 17, in which the impact element is arranged downstream of a fibre-supplying element such as a roller and immediately projects into the path along which in use material is projected by the element.

21. An apparatus according to any one of claims 1 to 17, in which the impact element projects into a path down which, in use, fibres fall freely.

22. An apparatus for measuring the amount of fibre flocks in a stream of flocks that are in flight during a spinning preparation process, the apparatus being substantially as herein described with reference to and

as illustrated by Fig. 1, or by Figs. 2a and 2b, or by Fig. 3a, or by Fig. 3b, or by Fig. 4a, or by Fig. 4b, or by Fig. 4c, or by Fig. 5a, or by Fig. 5b, or by Fig. 6, or by Figs. 7a and 7b, or by Fig. 8, or by Fig. 9, or by Fig. 10, or by Fig. 11, or by Fig. 12, or by Fig. 13a,or by Fig. 13b of the accompanying drawings.

23. A spinning preparatory machine including an apparatus according to any one of claims 2 to 22.

24. A method according to claim 1 employing an apparatus according to any one of claims 2 to 22.

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