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(54) Methods and apparatus for fibre preparation.

(57) The application of lubricants and other substances in fibre preparation machinery is regulated by measuring fibre mass flow rate through the machinery at a measuring position (14,51,45), applying lubricant to the fibre at a position (16) downstream of the measuring position, and controlling the rate of applicaion in accordance with the measured fibre mass flow rate after a delay corresponding to the time taken by the fibre to pass between the measuring and application positions.

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METHODS AND APPARATUS FOR FIBRE PREPARATION

This invention relates to methods and apparatus for fibre preparation and in particular to methods and apparatus for regulating the application of lubricants and other substances in fibre preparation machinery.

When baled fibres are opened it is often desired to apply to them lubricant or other substances such for example as tints and water-soluble antistatics. The lubricant or other substance is usually applied by spraying. The conventionally used spraying technique, however, results in uneven application of the lubricant or other substance, leaving some fibre relatively dry and other fibre with too much of the substance.

The present invention provides improved methods and apparatus.

The invention comprises a method for regulating the application of lubricants and other substances in fibre preparation machinery, comprising measuring fibre mass flow rate through the machinery at a measuring position, applying lubricant to the fibre at a position downstream of the measuring position and controlling the rate of application in accordance with the measured fibre mass flow rate after a delay corresponding to the time taken by the fibre to pass between the measuring and application positions.

The fibre mass flow rate may be measured by a weigh plate or a weigh belt and it may be measured upstream of a fibre opener, while the lubricant may be applied downstream of a fibre opener, as by spraying.

The fibre mass flow rate may otherwise be measured by a fibre metering arrangement in which a weigh pan or weighing hopper is filled until a predetermined load is indicated and then emptied on to a conveyor, the process being repeated at intervals, optionally with correction or compensation for weighing errors occasioned by in-flight fibre and taring the weighpan as required.

The rate of lubricant application may be controlled to be proportional to the fibre mass flow rate, and may be adjustable in relation to the fibre mass flow rate.

Lubricant and/or other substances may be added by spraying from a mixing arrangement in which a number of substances can be mixed together in predetermined ratios. Thus for example a mixture comprising 8% oil, 1% water, 0.5% Silicone, 0.25% antistatic agent and so on may be applied in a single spray mixed <u>en route</u> to the application position, and it may be arranged that the ratios can be altered during continuous operation either at will or in accordance with some operating variable such for example as moisture content of the fibre which might be measured by any convenient technique and used to control the rate of application of water relative to that of the other substances so as to give a uniform moisture content notwithstanding differences in moisture content from bale to bale.

The invention also comprises apparatus for regulating the application of lubricants and other substances in fibre preparation machinery, comprising fibre mass flow rate measuring means measuring fibre mass flow rate through the machinery at a measuring position, controllable rate applicator means for applying lubricants and other substances for the fibre at an application position downstream of the measuring position, and control means controlling the rate of application in accordance with the measured mass flow rate after a delay corresponding to the time taken by the fibre to pass between the measuring and application positions.

Said measuring means may comprise a weigh plate which may comprise electronic strain gauge type load cell means.

Said measuring means may otherwise comprise a weigh pan or weighing hopper arrangement in which the pan or hopper is filled with fibre until a predetermined load is indicated and then emptied on to a conveyor, the process being repeated at intervals so as to provide a metred flow of fibre to the preparation machinery.

Said controllable rate applicator means may comprise spray means which may comprise a cyclone arrangement in which fibre introduced tangentially into a cyclone chamber is air-induced to travel helically through the chamber where it is sprayed with lubricant or other substance. Said cyclone arrangement may include an axially extending spray nozzle support member.

A lubricant/other substances mixing arrangement may be provided in which reservoirs for the lubricant and/or other substances are connected through control valves to a mixing chamber, which may be held under pressure or from which the mixture may be pumped to the application position, e.g. the spray means.

The apparatus may comprise fibre detection means arranged to detect the presence of fibre and to control the spray of lubricant or other substance according as whether fibre is present or not. Such fibre detection means may comprise a microwave detector, which may be situated at the tangential fibre inlet to said cyclone arrangement.

Said control means may comprise a microprocessor adapted to receive fibre mass flow rate data from said fibre mass flow rate measuring means and to output control signals to valve means controlling the supply of lubricant or other substance to said controllable rate applicator means. Said microprocessor means may be programmed to control the supply of lubricant or other substance proportionally to the measured fibre mass flow rate, and may comprise input means by which a constant of proportionality can be adjusted. Said input means may comprise digital keyboard means and may be used for inputting other parameters and control information.

The control means may also control the ratios of substances, e.g. water, oil, silicone, antistatic agent according to a desired recipe. The control means may also change the recipe in accordance with an operating variable of the arrangement, for example moisture content of the fibre by including moisture content measuring means supplying moisture content information to the control means which may comprise a microcomputer programmed to adjust the ratio of water to other constituents of the mixture in response to changes in the measured moisture content.

Indicator means may be provided adapted to display the rate of application of lubricant or other substance to the fibre.

Said microprocessor means may be supplied with data indicative of the time taken for fibre to travel from the said measuring position to the said application position and to effect said delay in accordance therewith. Said microprocessor means may be programmed to adjust said delay in accordance with variations in the speed of fibre through the apparatus.

The invention also comprises fibre preparation machinery comprising such apparatus. Such fibre preparation machinery may comprise a fibre opener and the measurement position may be upstream and the application position downstream of said fibre opener.

Embodiments of apparatus and methods for regulating the application of lubricants and other substances in fibre preparation machinery according to the invention will now be described with reference to the accompanying drawings, in which :-

Figure 1 is a diagrammatic illustration of fibre preparation machinery incorporating the regulating apparatus;

Figure 2 is a diagrammatic illustration of a lubricating arrangement adapted for use in machinery as illustrated in Figure 1;

Figure 3 is a diagrammatic illustration of another form of fibre metering apparatus incorporated in the general arrangement of Figure 1;

Figure 4 is a diagrammatical illustration like Figure 1 incorporating another form of fibre metering apparatus;

Figure 5 is a diagrammatic illustration of a lubricant and/or other substance mixing arrangement.

The drawings illustrate methods and apparatus for regulating the application of lubricants and other substances in fibre preparation machinery.

Figure 1 illustrates a fibre opener 11 supplied with fibre 12 on a conveyor 13. The mass flow rate of the fibre 12 is measured by weigh plate means 14 comprising electronic strain gauge type load cells 15. The weigh plate means 14 measure the instantaneous load thereon; the mass flow rate is calculated from that measurement and the rate of passage of fibre 12 thereacross, which is dependent upon the speed of the conveyor 13.

Figure 3 illustrates another form of fibre metering apparatus incorporated in the apparatus illustrated in Figure 1 instead of the weigh plate 14. The apparatus of Figure 3 comprises a weigh pan or weighing hopper 51 which is suspended on load cells 52 connected to supply weight information to the microprocessor or microcomputer 18, which controls the doors 53 of the pan or hopper 51 and also the doors 54 of a fibre reservoir 55 above the pan or hopper 51. The reservoir 55 is filled from a conveyor 56 which is operated so as to maintain fibre in the reservoir between predetermined levels in known fashion.

The doors 54 are controlled so as to allow fibre to drop into the pan or hopper 51 until a predetermined load is indicated by the load cells 52. The doors 54 are then closed to prevent further fibre falling into the pan or hopper 51. In-flight fibre is allowed to settle in the pan or hopper 51 and the final weight therein as measured by the load cells is noted in the microprocessor or computer 18. The latter then opens the doors 53 so as to drop the contents of the pan or hopper 51 on to a conveyor 57 delivering the fibre to a fibre opener as in Figure 1. The process is then repeated at intervals so as to maintain a constant flow of fibre to the opener.

Such weigh pan or weighing hopper apparatus nowadays usually has sophisticated control arrangements correcting or compensating for the in-flight fibre which, if ignored, would result in a higher-than-expected fibre throughput. The actual throughput, however, as indicated by the final weight information from the load cells 52 is used to control the rate of application of lubricant/other substance downsteam.

Figure 4 illustrates, in the general arrangement of Figure 1, a weigh belt 45 in place of the weigh plate 14.

The weighed fibre 12 passes into the opener 11 which delivers opened fibre - which is then in its best state for the application of lubricant and other materials - to a lubricant or other material applicator 16 for application of lubricant such as mineral oil or oleines, tints, water soluble antistatics and so on. Treated material 12 is forwarded e.g. on conveyor means 17 to further processing or fabrication machinery (not shown).

The rate of application of lubricant or other material is controlled in accordance with the mass flow rate of fibre 11 as measured at the measuring position - weigh plate 14 - by a microcomputer controller 18 which controls valve means 19 in accordance with the mass flow rate of fibre 11 after introducing a delay corresponding to the time taken by the fibre 11 to pass between the measuring and applications positions.

The application of lubricant or other substance is illustrated in more detail in Figure 2. Lubricant or other substance 21 stored in containers 22, 23 is, if necessary, stirred by paddles 24 and heated by immersion heaters 25.

Two way valve means 26 control delivery of substance 21 from one or other of the containers 22, 23 through a pump unit 27 to a control valve 28 which regulates the supply of substance 21 to the fibre 11. A flow meter 29 has a digital read-out 31.

The substance 21 is delivered to a spray nozzle 32 in a support member 33 extending axially of a cyclone chamber 34 which essentially comprises a tapered duct with a tangential inlet 35 for the fibre 12 from the opener 11 and a swirl vane 36.

Filters 37 are disposed in the lubricant or other material supply line and on the inlets to the containers 22, 23.

Compressed air is supplied from a source 38 through a regulator 39 and an on/off control valve 41 through a nozzle pressure regulator 42 to the spray nozzle 32 where it atomises the lubricant or other substance from the nozzle 32 into a fine mist for dispersion on the fibres swirling through the cyclone chamber 34.

The processed fibres pass out of the open end of the cyclone chamber 34 on to suitable conveyor means for onward transmission to the next stage of a preparation or fabrication process.

The delay between an increase in fibre mass flow rate being observed at the weigh plate 14 and a corresponding increase in the supply of lubricant or other substance at the spray nozzle 32 is effected by the microprocessor 18. The necessary delay is a function of the separation between the weighplate 14 and the spray nozzle 30 and also of the speed with which fibre passes through the arrangement. Software of the microprocessor can provide for a nominal delay to be set in accordance with the separation in any arrangement of fibre preparation machinery and also to adjust the delay automatically on a change of throughput speed. The nominal delay may be set automatically on first introducing fibre to the arrangement as being the interval between a positive mass flow rate first being detected at the weighplate 14 and fibre being detected at a microwave fibre sensor 43 situated at the entrance to the cyclone chamber 34.

The microprocessor 18 has keyboard input means 44 by which a constant of proportionality between the lubricant or other substance and the fibre can be set - if a 5% add-on, say, of lubricant is required, setting this value is arranged to control valve 28 and/or pump unit 37 to deliver lubricant at an instantaneous mass flow rate equal to 5% of that of the fibre as measured at the weigh plate 14, but after the necessary delay.

Figure 5 illustrates an arrangement for mixing lubricant and/or other substances according to a recipe which might, for example, be 8% water add-on, 1% oil, 0.5% silicone, 0.25% antistatic agent and so on. Six reservoirs 61-66 are provided in this arrangement connected by metering control valves 61a-66a to a manifold 67 feeding a mixing tank 68 connected to the cyclone arrangement of Figure 2. The tank 68 can be maintained under pressure or a pump 69 can be incorporated in the line to the cyclone.

The valves 61a-66a and/or tank 68 pressurisation and/or the pump 69 are controlled from the microprocessor or computer 18 which is programmed to adjust the ratios of the different substances supplied to the tank 68 from the reservoirs 61-66 in accordance with e.g. keyboard input instructions according to a desired recipe.

A moisture content sensor 71, which may be associated with the weighplate 14 or weighpan or hopper 51 can be connected to the microprocessor 18 as shown which can then be programmed to alter the ratio of water to other substances supplied to the mixing tank 68 in accordance with the moisture content of the fibre as measured by the sensor 71.

The microprocessor 18 can also be connected to other sensors and/or controls of the system, for example to level sensors in the containers 22, 23 or 61-66 to give visual or audible warning of an empty container and perhaps also to automatically switch the valve 26 to take lubricant from a full container when the other has emptied, and also to control the lubricant temperatures in the containers 22 and 23 or 61-66.

Claims

1. A method for regulating the application of lubricants and other substances in fibre preparation machinery, characterised by comprising measuring fibre mass flow rate through the machinery at a measuring position (14,51,45), applying lubricant to the fibre at a position (16) downstream of the

measuring position and controlling the rate of application in accordance with the measured fibre mass flow rate after a delay corresponding to the time taken by the fibre to pass between the measuring and application positions.

2. A method according to claim 1, characterised in that the fibre mass flow rate is measured by a weigh plate (14) or a weigh belt (45).

3. A method according to claim 1 or claim 2, characterised in that the fibre mass flow rate is measured upstream of a fibre opener (11).

4. A method according to any one of claims 1 to 3, characterised in that lubricant is applied downsteam of a fibre opener (11).

5. A method according to any one of claims 1 to 4, characterised in that lubricant is applied by spraying.

6. A method according to any one of claims 1 to 5, characterised in that the rate of lubricant application is controlled to be proportional to the fibre mass flow rate.

7. A method according to any one of claims 1 to 6, characterised in that the rate of lubricant application is adjustable in relation to the fibre mass flow rate.

8. Apparatus for regulating the application of lubricants and other substances in fibre preparation machinery characterised by comprising fibre mass flow rate measuring means (14,51,45) measuring fibre mass flow rate through the machinery at a measuring position, controllable rate applicator means (16) for applying lubricants and other substances to the fibre at an application position downstream of the measuring position, and control means (18) controlling the rate of application in accordance with the measured mass flow rate after a delay corresponding to the time taken by the fibre to pass between the measuring and application positions.

9. Apparatus according to claim 8, characterised by said measuring means comprising a weigh plate (14) or weigh belt (45).

10. Apparatus according to claim 8 or claim 9, characterised in that said weigh plate (14) or weigh belt (45) comprises electronic strain gauge type load cell means (15).

11. Apparatus according to any one of claims 8 to 10, characterised in that said controllable rate applicator (16) comprises spray means.

12. Apparatus according to claim 11, characterised in that said spray means comprise a cyclone arrangement in which fibre introduced tangentially into a cylcone chamber (34) is air-induced to travel helically through the chamber where it is sprayed with the lubricant or other substance.

13. Apparatus according to claim 12, characterised in that said cyclone arrangement includes an axially extending spray nozzle support member (33).

14. Apparatus according to any one of claims 8 to 13, characterised by comprising fibre detection means (43) arranged to detect the presence of fibre and to control the supply of lubricant or other substance.

15. Apparatus according to claim 14, characterised in that said fibre detection means (43) comprising a microwave detector.

16. Apparatus according to claim 12 or claim 13, characterised by comprising a microwave fibre detector (43) at the tangential fibre inlet (35).

17. Apparatus according to any one of claims 8 to 16, characterised in that said control means (18) comprise a microprocessor adapted to receive fibre mass flow rate data from said fibre mass flow rate measuring means (14,51,45) and to output control signals to valve means (19) controlling the supply of lubricant or other substances to said controllable rate applicator means (16).

18. Apparatus according to claim 17, characterised in that said microprocessor means (18) are programmed to control the supply of lubricant or other substance proportionally to the measured fibre mass flow rate.

19. Apparatus according to claim 18, characterised in that said microprocessor means (18) comprise input means (44) by which a constant of proportionality can be adjusted.

20. Apparatus according to claim 19, characterised in that said input means (44) comprise digital keyboard means.

21. Apparatus according to any one of claims 8 to 20, characterised by comprising indicator means (29,31) adapted to display the rate of application of lubricant or other substance to the fibre.

22. Apparatus according to any one of claims 17 to 20, characterised in that said microprocessor means (18) are supplied with data indicative of the time taken for fibre to travel from the said measuring position (14,51,45) to the said application position (16) and to effect said delay in accordance therewith.

23. Apparatus according to claim 22, characterised in that said microprocessor means (18) are programmed to adjust said delay in accordance with variations in the speed of fibre through the apparatus.

24. Fibre preparation machinery comprising apparatus according to any one of claims 8 to 23.

25. Fibre preparation machinery according to claim 24, characterised by comprising a fibre opener (11).

26. Fibre preparation machinery according to claim 25, characterised in that said measurement position is upstream of the fibre opener (11).

27. Fibre preparation machinery according to claim 26, characterised in that said application position is downstream of said fibre opener (11).

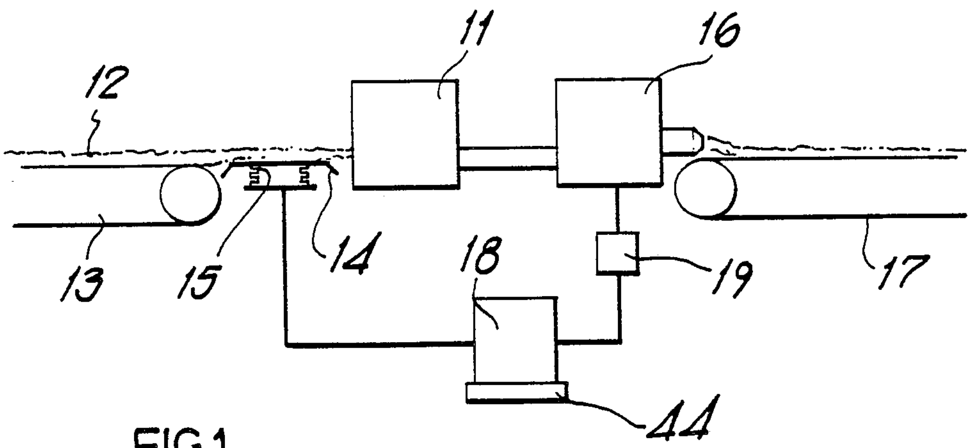
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FIG.1

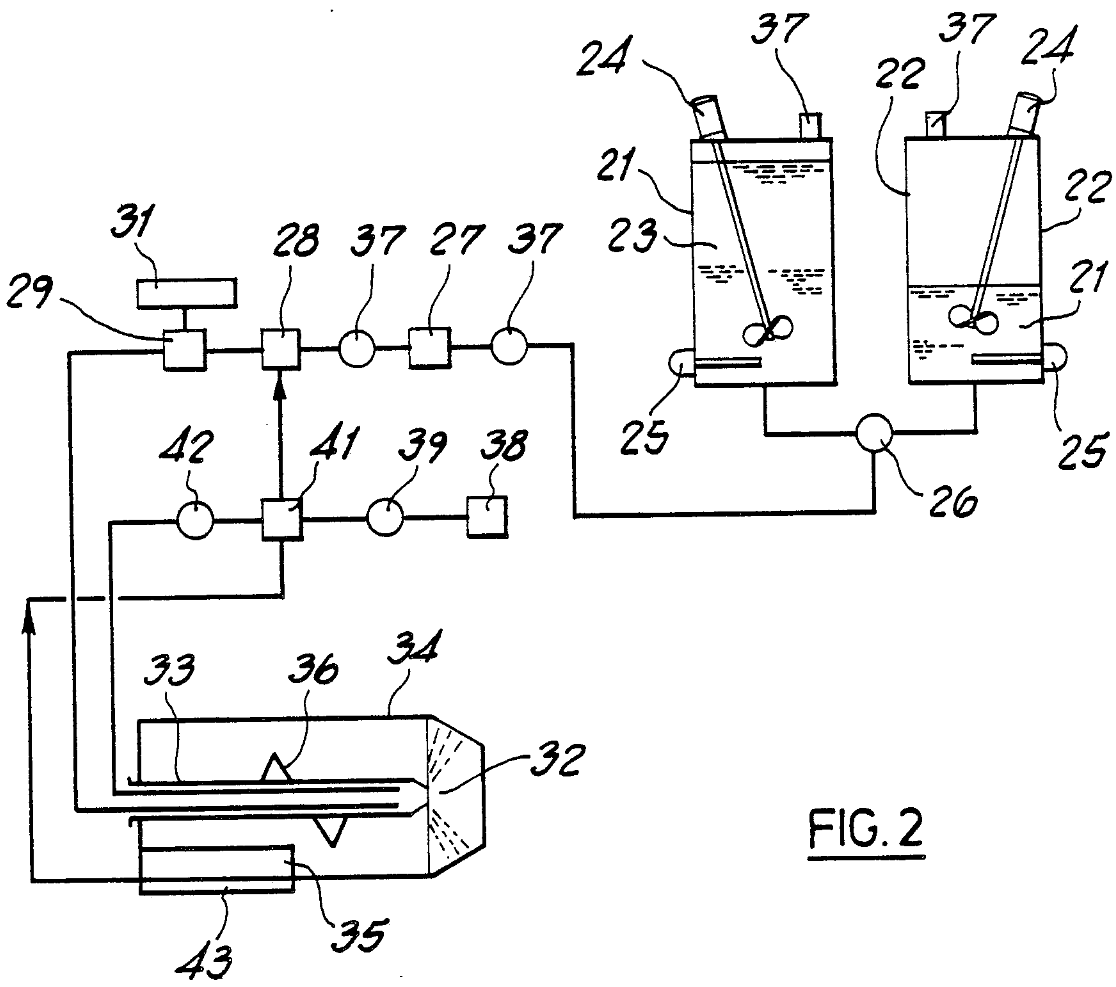
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FIG. 2

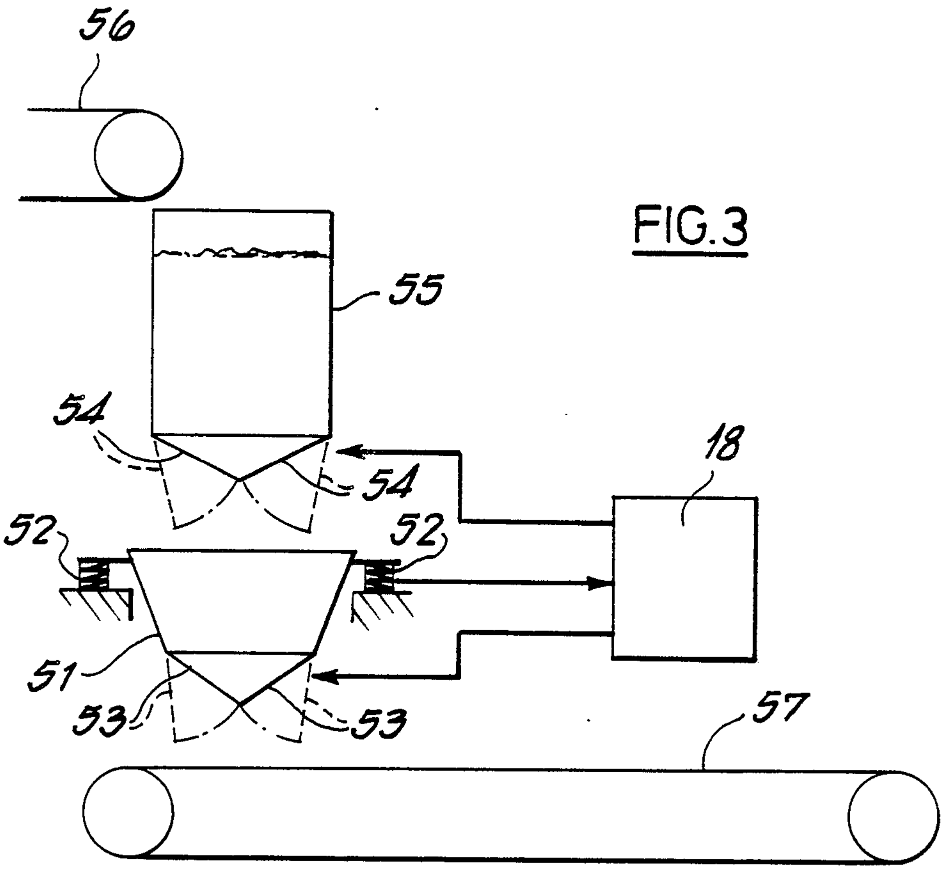
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FIG.3

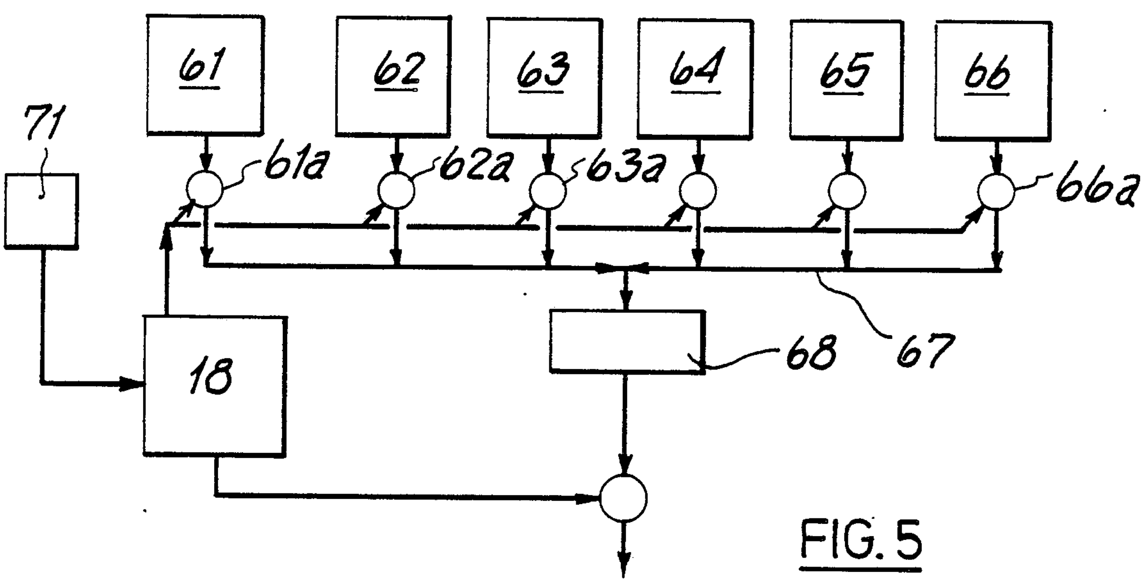
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FIG.5

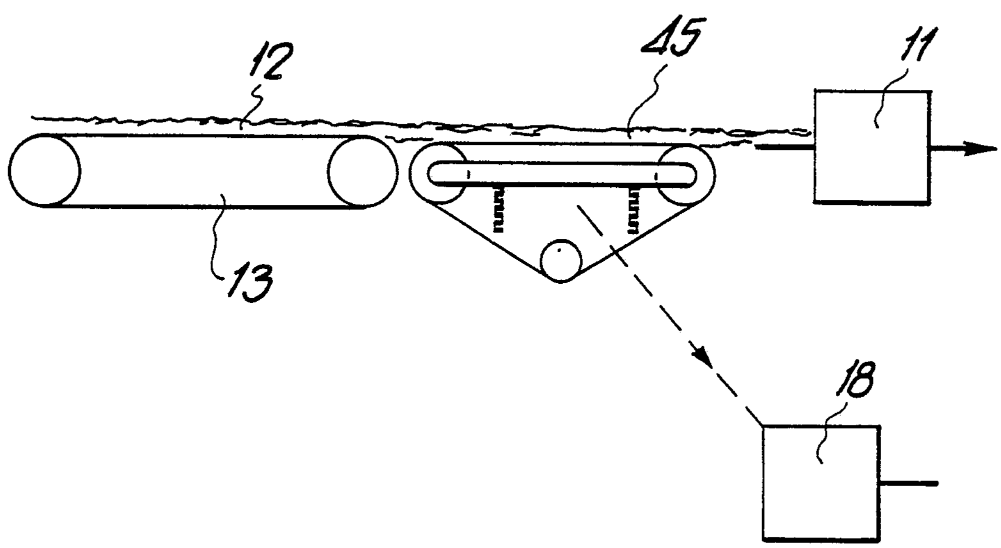

FIG. 4