May 23, 1967 P. EPPENBERGER 3,321,144

METERING AND CONTROL DEVICES FOR FEEDER APPLIANCES

Filed Jan. 6, 1964 3 Sheets-Sheet 1

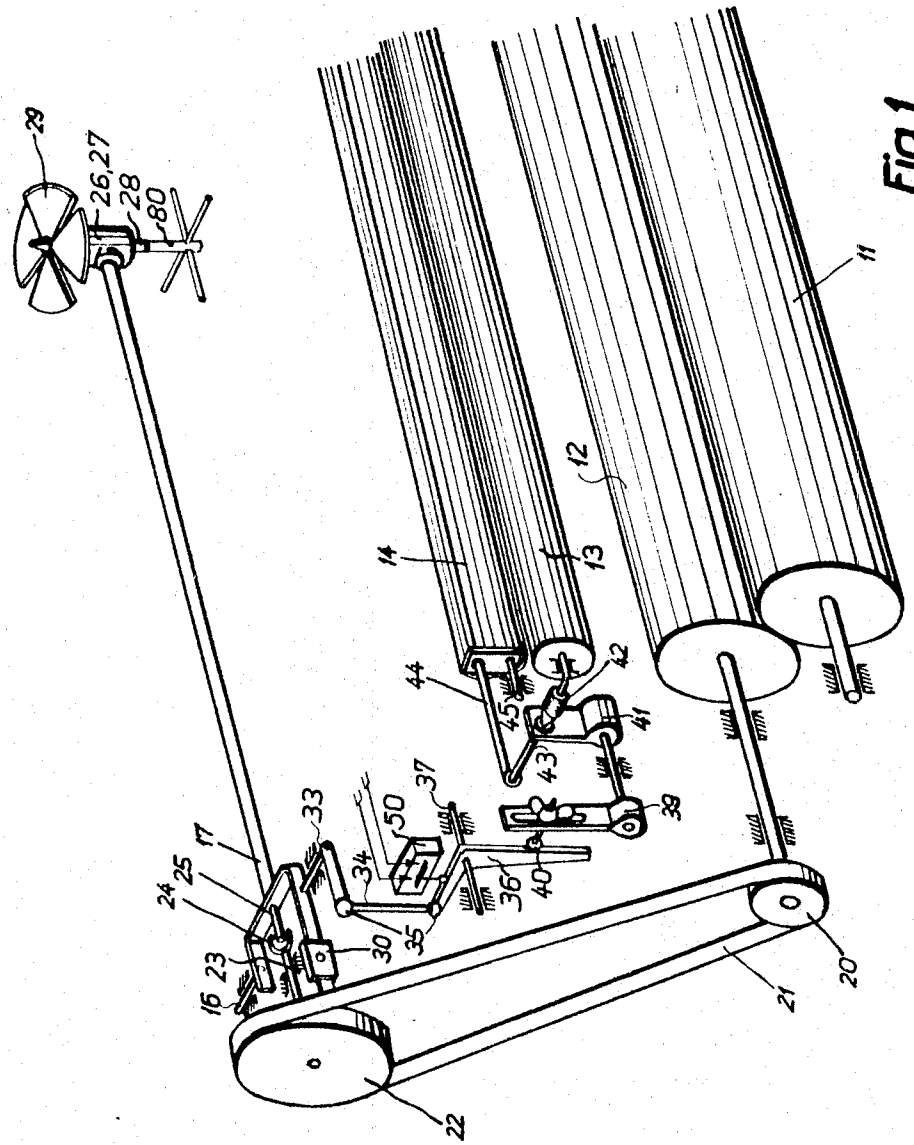

Fig. 1

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METERING AND CONTROL DEVICES FOR FEEDER APPLIANCE

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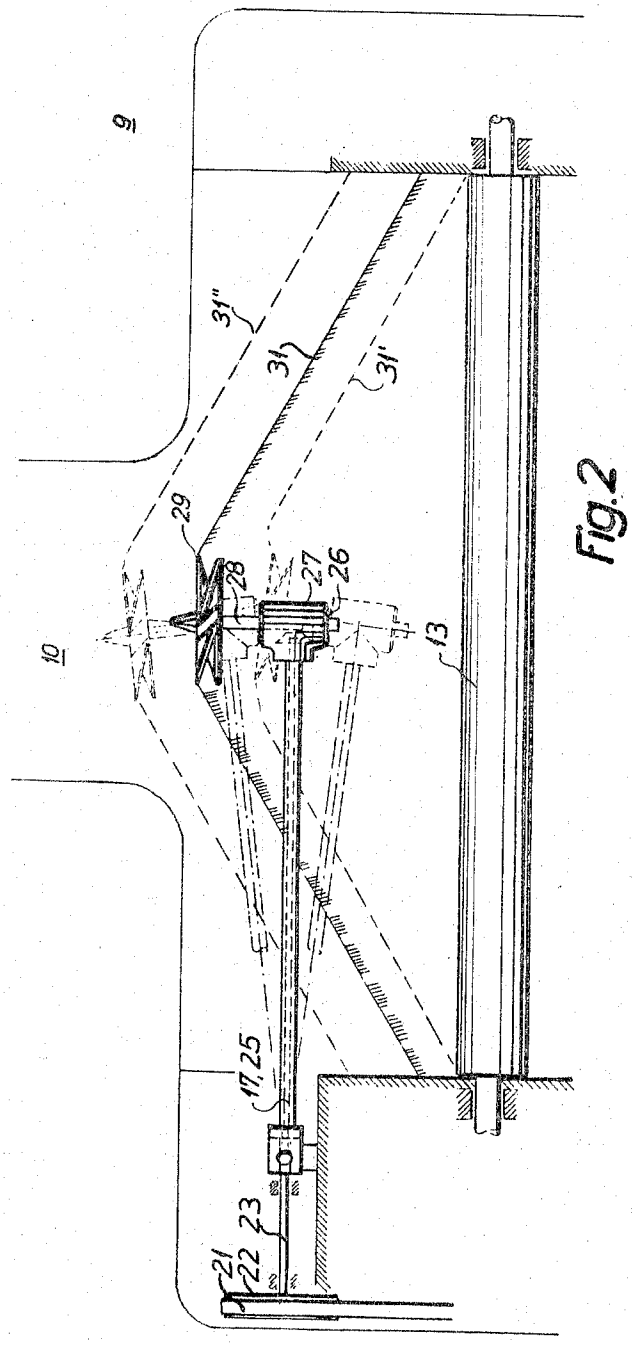

Fig. 2

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METERING AND CONTROL DEVICES FOR FEEDER APPLIANCES

Filed Jan. 6, 1964 3 Sheets-Sheet 3

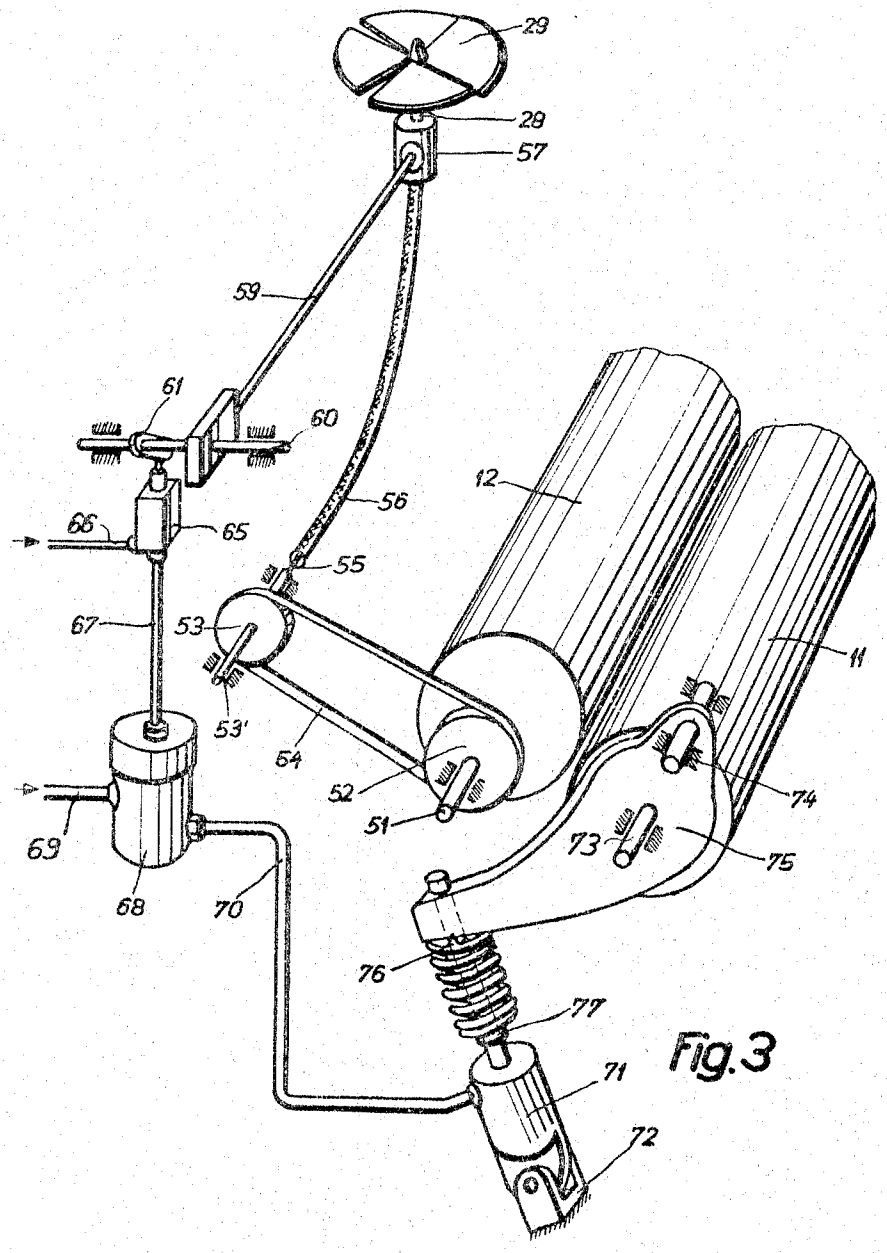

Fig. 3

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METERING AND CONTROL DEVICES FOR FEEDER APPLIANCES

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8 Claims. (Cl. 241—34)

In treatment machines having feeder devices which are controlled in dependence on the inflowing mass flow of goods with a uniform distribution of the goods over a certain width, measuring and controlling devices have already been proposed.

There is known a surveying device suspended on a spring and provided with lateral arms, and which thus forms a float-like body. This surveying device reacts on the velocity of the goods flowing through. It has, however, the disadvantage that upon variation in the grain size of the goods the measuring result is also varied.

It is also known to have float-bodies raised by the goods to be treated and to be lowered onto the level of the goods. The position of the float-body resulting from the lowering are transformed into electric values, and the latter are used for the control. This results in a bulky and expensive construction of the device, and this bulky and expensive construction must be eliminated, particularly for auxiliary devices.

The invention has the object of providing a novel and advantageous measuring and controlling arrangement for feeder devices on treatment machines for granular or pulverulent materials.

In accordance with the invention, a control device for the flow of granular of pulverulent material is provided which includes a feeder device or hopper having a feeder gap or valving means and a control element controlling the width of the feeder gap. A driven vane wheel or propeller operates inside that part of the material upstream of the feeder gap in such a manner that the propeller always works itself up to the surface of the material. This vane wheel or propeller is operatively connected with a control element and, by virtue of the rise and fall of the vane wheel or propeller in accordance with the rise and fall of the level of the surface of the material upstream of the feeder gap, the feeder gap or flow cross section area is widened or narrowed.

A further feature of the invention resides in the provision of a substantially balanced lever supporting the vane wheel or propeller, and novel drive means are also provided. Furthermore, the invention provides novel means for the connection of the feeler element or propeller or vane wheel with the feeder device in a controlling manner. Adjustable transmission means and fine adjusting means are further provided for accurate and fine control of the feed of the material.

An ancillary feature of the invention is the provision of a distributing device for the goods, this distributing device cooperating with the feeler element and preferably being driven in common therewith.

By using a constantly rotating vane wheel operating on the principle of a propeller in a medium capable of flowing, it is possible to ascertain continuously the level of the heaped material, and at the same time, in dependence on that level, to influence control elements, e.g. for the width of the gap between a feeder slide and a feeder roller. Thus the advantage is attained of metering and, combined therewith, of controlling the flow in a graduated manner with a short time constant, a low energy requirement and a steady fine adaptation to very small variations in the goods measured, while obviating the danger of choking and jamming. Thereby, as the measuring is not made dependent on the resistance to flow, considerably more accurate metering is achieved.

The accompanying drawings show for example two embodiments of a roller mill according to the invention, structural details such as bearings, casings and the like, being indicated only diagrammatically.

FIG. 1 shows a first embodiment of the feeler and control device, in perspective illustration.

FIG. 2 shows the feeler element of the control device according to FIG. 1, in elevation.

FIG. 3 shows the control device as a control member of a second embodiment, in perspective illustration.

In a roller mill 9 illustrated in FIGS. 1 and 2 in a considerably simplified manner and having a drop shaft 10 on top for filling the same, two rollers 11 and 12 are journaled. These two mill rollers are associated with a feeder roller 13 adjacent a feeder flap 14. For controlling the feeder gap between the feeder roller 13 and the feeder flap 14, a level feeler element 15 is arranged on a lever 17, which is pivotable about a pivot axle 16. This level feeler element 15 is driven from the mill roller 12 through a driving pulley 20 mounted on the same shaft, an endless belt 21 and a driven pulley 22, which is mounted on a shaft 23 which, through a universal joint 24, is joined to the shaft 25 of the feeler. A casing 26 encloses a bevel gearing 27 and associated propeller shaft 28. The propeller shaft 28 carries on top a propeller 29. On the end of the pivot axle 16 opposite the lever 17 a counterpoise 30 is provided, which keeps the lever 17 with the level feeler element 15 almost in a balanced position. By the location of the propeller 29, the same keeps working itself always to the surface of the cone 31 formed by the material to be milled. Variations in the height of the cone 31 cause variations in the position of the propeller 29 and accordingly variations in its angle relative to the axis of rotation 16. These variations in the angle are transmitted through an arm 33 and, through a ball joint rod 34 with two ball ends 35, to a bell crank lever 36, which is mounted on a pivot axle 37. By means of the transmission lever 39, which is provided with an adjustable finger 40 for the adaptation of the transmission ratio, the variations in said angle are transmitted at a suitable ratio to the fine adjustment lever 41. This fine adjustment lever 41 carries a fine adjustment nut 42, which is mounted slidably on a fine adjustment spindle 43. This fine adjustment spindle 43 is connected through a flap operating rod 44 with the feeder flap 14, which is pivotably mounted on flap pivot pins 45. Corresponding to the lowest position of the level feeler element 15, a limit switch 50, for example, is arranged on the bell crank lever 36. From this arrangement the following manner of operation follows:

The material to be milled reaches the roller mill 9 through the drop shaft 10 and forms a cone 31 above the feeder roller 13 and feeder flap 14. Depending on the height of this cone 31 of the material to be milled, a certain position of the level feeler element 15 is adjusted, which element is formed by the propeller 29 arranged above the casing 26 of the bevel gearing 27. During the operation of the mill rollers 11 and 12, with which the propeller 29 is coupled through the belt drive 20, 21, 22 and the linkage 23, the universal joint 24 and the rod 25, this propeller always works itself up to the level of the material. When the propeller 29 rises, the arm 33 performs a downward movement, which causes a forward movement of the bell crank lever, whereby the feeder flap is opened wider and the cone 31 of the material to be milled is accordingly more rapidly reduced in height. Thus a steady fine adaptation of the feeder gap to the mass flow of the inflowing material and outflowing material is obtained. This causes also an optimum exploitation and a uniform milling of the material, since the material to

be milled is always distributed over the full width of the feeder gap and accordingly over the full width of the mill. When the cone **31** is below a predetermined height, e.g. the level **31'** according to FIG. 2, the switch **50** responds and the complete mill is brought to a standstill thus saving the mill rollers. By means of the finger **40** on the transmission lever **39** opposite the bell crank lever **36**, the transmission ratio may be adjusted in a simple manner, while a very fine adjustment may be effected by the fine adjustment nut **42** on the fine adjustment spindle **43**. By this arrangement the level feeler element and consequently the whole control and regulating device may be adapted to any desired material to be milled.

The device described constitutes a simple quickly responding mechanical control plant. It is characterised by a simple construction and a very fine response accuracy. At the same time the structural requirements of the apparatus are reduced to a minimum.

With reference to FIG. 3, a level feeler element according to the invention, for the control of a hydraulic roller mill, is described herein as a development of the invention. A further possibility for the level feeler element will also be illustrated. Mill rollers **11** and **12** which are driven in the conventional manner are likewise journalled in this roller mill. On the axle **51** of the roller **12** a driving pulley **52** is mounted, which is in driving connection with the pulley **53** arranged on a separate axle, the transmission being effected by an endless belt **54**. The shaft **53'** of the driven pulley **53** is likewise connected with a flexible shaft **55** which is guided in a flexible sheath **56**. In a casing **57** of the feeler element, wherein the propeller shaft **28** and the propeller **29** are journalled, the connection between the flexible shaft **55** and the propeller shaft **28** is established. The casing **57** of the feeler element is mounted on a lever **59**, which is articulated by means of the axle **60** to the machine frame. While the regulation of the feeder gap may be carried on in the manner described hereinabove, a hydraulic disengagement device is here provided instead of the switch **50**. On the axle **60** there is mounted an actuator arm **61**, which, in a predetermined lowest position of the level feeler **15**, acts on a control valve **65**, which is supplied by a control pipe **66**. This control valve **65** is in communication by a pipe **67** with a power valve **68**, which is connected by a pipe **69** with a pressure medium system. This power valve **68** acts through a pressure medium pipe **70** on a working cylinder **71** which is articulated to abut a fixed point **72** of the roller mill. The mill roller **11** is in turn journalled with its trunnion **73** in a bracket **75** pivotably mounted on a pivot pin **74**, which bracket rests on a spring seated on a chimb **77** of a piston rod **76**. An identical mounting of the mill roller **11** is provided at the opposite end thereof.

This arrangement serves for the following manner of operation:

In a lowest position of the propeller **29** the control valve **65** is actuated by the arm **61**. Thereby the power valve **68** is opened and the piston in the cylinder **71** performs a downward movement, whereby the bracket **75** is carried downward by the piston rod **77** and the roller **11** moves away from the roller **12**. Thereby any damage to the mill rollers for lack of material is made impossible.

By this arrangement of the device the control and regulating system for the feeding of the roller mill may be built into the hydraulic pressing system of the mill rollers. Consequently the mill rollers move very quickly apart when material to be milled is lacking, whereby a reliable manner of operation of the whole plant is secured.

Referring again to FIG. 1, a feature of the invention is the provision of a distributing device for the material, in operative association with the propeller **29**. Such a distributor has a proven value for the uniform distribution of the material to be treated over the whole feeder and treatment width. As illustrated in FIG. 1, the distributor is in the form of a cross **80** secured to the lower end of the propeller shaft **28** adjacent the bottom wall of casing **26**.

This arrangement has the advantage that the same driven element serves for the metering as well as for the uniform distribution of the material to be treated over the feeder device.

The control and regulating device described may be modified in various respects without departing from the principle of the invention. There exists, for example, the possibility of providing instead of a linkage rod combination between the feeder roller and the feeder flap for the mechanical variation of the width of the feeder gap, a potentiometer arrangement, whereby the rotary speed of the feeder valve can be varied.

The metering and control arrangement described is not limited to feeder devices of roller mills, but may be associated with any treatment machines, wherein materials capable of flowing are treated. By the device according to the invention, the disadvantages mentioned hereinabove are obviated in a simple manner.

While I have herein described and illustrated in the accompanying drawings what may be considered typical and particularly useful embodiments of my said invention, I wish it to be understood that I do not limit myself to the particular details and dimensions described, and illustrated; for obvious modifications will occur to a person skilled in the art.

What I claim as my invention and desire to secure by Letters Patent is:

1. In combination with a hopper for flowable granular or pulverulent material and variable flow outlet valving means controlling flow of material from the hopper: a flow control device comprising, in combination, a rotatable vane in said hopper as a sensing device for the level of material in said hopper; a lever having one end supporting said rotatable vane; mounting means outside said hopper pivotally mounting said lever at a point thereon spaced from said one end; driving means for said rotatable vane operable to rotate the vane to work its way to the surface of the material in the hopper, whereby said lever is pivoted about its mounting means so that the angular position of said lever follows the level of material in said hopper; said driving means including a drive shaft connected to said rotatable vane and extending, in totally enclosed relation, to said rotatable vane from a point exteriorly of said hopper; and control elements operatively connected between said lever and said valving means and controlling the flow cross sectional area of said valving means in accordance with the level of material in said hopper.

2. A control device, as claimed in claim **1**, in which said mounting means pivotally mounts said lever at a point on said lever intermediate its ends, and a counterpoise mounted at the opposite end of said lever and substantially balancing said rotatable vane.

3. A control device, as claimed in claim **1**, in which said drive shaft is enclosed within said lever.

4. A control device for the flow of granular or pulverulent material, comprising, in combination: a feeder device having a feeder gap, a control element controlling the width of said feeder gap, and a driven vane wheel operating inside that part of said material upstream of said feeder gap so as to work itself always to the surface of said material, said vane wheel being in operative connection with said control element and by its rise and fall following the level of the surface of said material narrowing and widening, respectively, said feeder gap, a two-armed lever carrying said vane wheel at one arm and having a counterpoise mounted at the other arm substantially balancing said vane wheel, and a transmission means arranged on said lever in driving connection with said vane wheel.

5. A control device for the flow of granular or pulverulent material, comprising, in combination: a feeder device having a feeder gap, a control element controlling

the width of said feeder gap, and a driven vane wheel operating inside that part of said material upstream of said feeder gap so as to work itself always to the surface of said material, said vane wheel being in operative connection with said control element and by its rise and fall following the level of the surface of said material narrowing and widening, respectively, said feeder gap, a two-armed lever carrying said vane wheel at one arm and having a counterpoise mounted at the other arm substantially balancing said vane wheel, and a flexible shaft arranged on said lever in driving connection with said vane wheel.

6. A control device for the flow of granular or pulverulent material, comprising, in combination: a feeder device having a feeder gap, a control element controlling the width of said feeder gap, and a driven vane wheel operating inside that part of said material upstream of said feeder gap so as to work itself always to the surface of said material, said vane wheel being in operative connection with said control element and by its rise and fall following the level of the surface of said material narrowing and widening, respectively, said feeder gap, a two-armed lever carrying said vane wheel at one arm and having a counterpoise mounted at the other arm substantially balancing said vane wheel, a rod-linkage combination connecting said lever carrying said vane wheel with said control element controlling the width of said feeder gap, and a transmission device adjustable at will interposed in said rod-linkage combination.

7. A control device for the flow of granular or pulverulent material, comprising in combination: a feeder device having a feeder gap, a control element controlling the width of said feeder gap, and a driven vane wheel operating inside that part of said material upstream of said feeder gap so as to work itself always to the surface of said material, said vane wheel being in operative connection with said control element and by its rise and fall following the level of the surface of said material narrowing and widening, respectively, said feeder gap, and a distributor device for said material co-operating with said vane wheel and distributing said material homogeneously over said feeder device, said distributor device comprising a rotary cross in driving connection with said vane wheel.

8. A control as claimed in claim 1, including a treatment device downstream of said valving means and fed with material through said valving means, and a limit switch cooperating with said lever carrying said vane wheel, said limit switch being operated by said lever when the material in said hopper decreases to a predetermined level, and said limit switch, when operated, interrupting operation of said treatment device.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,321,144 May 23, 1967

Paul Eppenberger

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, line 5, for "Oberuzwil" read -- , Uzwil --.

Signed and sealed this 15th day of April 1969.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents