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FEEDING OF POWDER OR OTHER FLUENT MATERIALS
OF SUBSTANTIALLY EQUAL QUANTITIES
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FIG. 1.

FIG. 2.

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The invention relates to the feeding of powder or other fluent material such as, for example, granulated, flaky or other comminuted materials, in substantially equal quantities. Such materials will be referred to herein simply as "powder." The invention is particularly concerned with the feeding of powder in a continuous substantially uniform stream towards a series of delivery funnels which are moved in succession through the stream in such a manner that each receives the stream for substantially the same predetermined period, the powder then passing from such funnel to a discharge end movable in register with each funnel while it passes through the stream. Provided that the stream of powder flows at a substantially constant rate, therefore, each container receives substantially the same predetermined quantity of powder by volume.

It is sometimes found, however, that whilst the quantities received by the successive containers are substantially equal by volume, the weight of the volume changes from time to time for a variety of reasons depending to some extent on the kind of powder being fed. Thus, powder of a given kind may vary in density by reason of atmospheric changes or by variation in the size of the individual particles making up the powder; or again by the degree of aeration given to the powder by turbulence during the feeding operation.

An object of the invention is to vary the rate of flow of the stream of powder in accordance with variation in the density of the powder so that the quantities received by the containers will be substantially equal in weight. According to the present invention, powder is continuously fed in a stream at a predetermined rate towards the containers, the stream being arranged to impinge on a vane carried by a pivoted arm so as to cause that arm to tend to rotate about its pivot, the arm being yieldably pre-loaded against such rotation by an amount sufficient substantially to balance the load applied to the vane by the predetermined rate of flow of the powder, and means responsive to any sensible movement of the pivoted arm from its normal position of balance are provided for varying the rate of flow of the stream to restore the balance.

The stream of powder is conveniently produced by an electro-magnetic vibrating feed device of known kind, the speed of operation of the device (and thus the rate of flow of the powder) being controlled by an electrical control unit. With such construction, the means for varying the rate of flow may consist of an air-operated two way switch wired in the circuit of the control unit, the switch being under the control of an air-controller of the "Solex" type having an air jet impinging on an arcuate surface mounted on the vane-carrying arm, the surface being disposed eccentrically with respect to the pivotal axis of the arm so that pivotal movement of the arm varies the gap between the jet and the surface, thus producing the differential pressure for operating the switch.

The stream of powder conveniently falls down a chute the discharge end of which is arranged above the path of movement of a series of delivery funnels carried by a rotatable drum, the discharge outlets from the delivery funnels, in turn being arranged above the path of movement of a series of cartons carried by a conveyor so arranged that each carton moves into register with a funnel before that funnel passes the chute.

To provide for variation in the speed of operation of the apparatus while maintaining the same quantity of powder in the cartons, means may be provided for automatically varying the amount of pre-loading of the vane-carrying arm in proportion to the variation in speed of the apparatus, so as to maintain the normal balance of the arm in spite of variation in the rate of flow of powder necessary for different speeds of operation of the apparatus.

By way of example, the invention will now be described in greater detail with reference to the accompanying drawings, as applied to an apparatus for packaging powder in cartons.

In the drawings:

Figure 1 represents diagrammatically such an apparatus, and

Figure 2 is an end view of the apparatus.

In general, powder is fed from a main feed pipe 1 into a tray 13 of channel section which is vibrated by an electro-magnetic vibratory feed device 13 of known construction, the rate of operation of the device being variable by an electrical control unit 14. The tray 12 discharges a stream of powder into a chute 16 arranged above a rotatable conveyor belt 18 on the periphery of which are arranged a series of continuous discharge funnels 20 the upper edges of which are sufficiently sharp to avoid powder accumulating on the edges. The chute 16 is so arranged that each discharge funnel 18 passes in turn below the outlet of the chute.

Below the carrier member 17 is arranged a chain conveyor 19 carrying a spaced succession of cartons 21, the conveyor 19 guiding the successive cartons 21 into register with successive funnels 18 and maintaining them in such registration over about 180° of the movement of the carrier member 17. In this manner, each carton 21 receives the stream for substantially the same predetermined period, and assuming uniformity of flow, therefore, each carton receives substantially the same predetermined quantity of powder by volume.

Flely pivoted at 22 in anti-friction bearings is an arm 23 carrying a vane 24 passing into the chute 16 and extending transversely into the path of movement of the stream. The channel 12 discharges into a tube 26 of smaller diameter than the width of the vane 24, and the adjacent edge of the tube 26 acts as a limit stop for the vane 24, the latter being yieldably urged towards the stop by a plung 27 slidably mounted in a housing 28 and urged into contact with the arm 23 by a spring contained within the housing 28. The spring pre-loads the vane 24 against pivotal movement under the influence of the stream, the amount of pre-loading being sufficient substantially to balance the load applied to the vane 24 by the predetermined rate of flow of the powder.

The arm 23 is provided with a curved surface 29 eccentric to the pivot 22, and there is arranged adjacent the surface 29 a nozzle 31 from which an air jet is arranged to impinge on the surface 29. The nozzle 31 is provided with compressed air at a normally constant pressure by an air-controller 32 of the type well known under the name "Solex," air at the same pressure passing through a branch 33 to a chamber 34 housing a two-way control switch 36 operable by a spring loaded diaphragm 37, the switch being connected in the circuit of the control unit 14.

It will thus be seen that pivotal movement of the arm...
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23 causes a variation in the gap between the nozzle 31 and the surface 29 thus causing a variation in the pressure of the air entering the chamfer 34, with the result that the switch is actuated by the diaphragm one way or the other to operate the control unit 14 to vary the rate of operation of the vibratory device 13.

With the vane arm 24 pre-loaded to suit the rate of flow of powder necessary to provide a given quantity in the cartons 21, therefore, it will be seen that any sensible change in the density of the powder will cause pivotal movement of the vane 24 in one direction or the other according as the powder is heavier or lighter than normal, such movement of the vane 24 varying the air gap mentioned above to operate the switch 34 one way or the other to decrease or increase the rate of feed of the powder by the feed device 13 as the case may be. In this manner, variation in the weight of the powder fed to successive cartons 21 can be maintained between tolerable limits.

To provide for variation in the speed of operation of the apparatus while maintaining the same quantity of powder in the cartons, the amount of pre-loading of the arm 23 is automatically varied in proportion to the variation in speed of the apparatus. This is brought about in the present example by the provision of a pilot motor 38 connected by gearing 39 to a screw device within the housing 28 for increasing or decreasing the tension on the spring urging the plunger 27 into engagement with the arm 23. The motor 38 is identical with and connected in the circuit of the pilot motor 41 operating a variable speed main motor 42 for driving the apparatus. Any change in the desired speed of operation of the apparatus, therefore, immediately produces a corresponding change in the pre-loading of the vane 24 so as to maintain the normal balance of the vane in spite of the necessary change in the rate of flow of the powder.

I claim:

1. Packaging apparatus for feeding successive predetermined quantities of powder to successive containers in which the powder is fed in a continuous stream at a controlled rate towards a delivery station through which the containers pass in succession, said apparatus comprising a vane carried by a pivoted arm and so arranged that the stream will impinge on the vane so as to cause that arm to tend to rotate about its pivot, means for yieldably pre-loading the arm against such rotation by an amount sufficient substantially to balance the load applied to the vane by the predetermined rate of flow of the powder, means responsive to any sensible movement of the pivoted arm from its normal position of balance for varying the rate of flow of the stream to restore the balance, forwarding means for moving the containers through the stream, and means responsive to variation in the speed of the forwarding means for varying the pre-loading of the vane-carrying arm in the direction and in the amount so that the quantity of powder fed to the successive containers is substantially constant.

2. Packaging apparatus for feeding successive predetermined quantities of powder to successive containers in which the powder is fed in a continuous stream at a controlled rate towards a delivery station through which the containers pass in succession, said apparatus comprising a vane carried by a pivoted arm and so arranged that the stream will impinge on the vane so as to cause that arm to tend to rotate about its pivot, means for yieldably pre-loading the arm against such rotation by an amount sufficient substantially to balance the load applied to the vane by the predetermined rate of flow of the powder, means responsive to any sensible movement of the pivoted arm from its normal position of balance for varying the rate of flow of the stream to restore the balance, forwarding means for moving the containers through the stream, and means responsive to variation in the speed of the forwarding means for varying the pre-loading of the vane-carrying arm, a screw device for varying the tension in the spring means, a pilot motor connected by gearing to the screw device, an identical motor wired in the circuit of the pilot motor and adapted to operate a variable speed main motor for driving the machine.

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