April 18, 1961 F. FAHRNI 2,980,290

METHOD AND DEVICE FOR THE FORMATION OF A STREAM OF PARTICLES OF CONSTANT LAYER THICKNESS

Filed Jan. 16, 1957 2 Sheets-Sheet 1

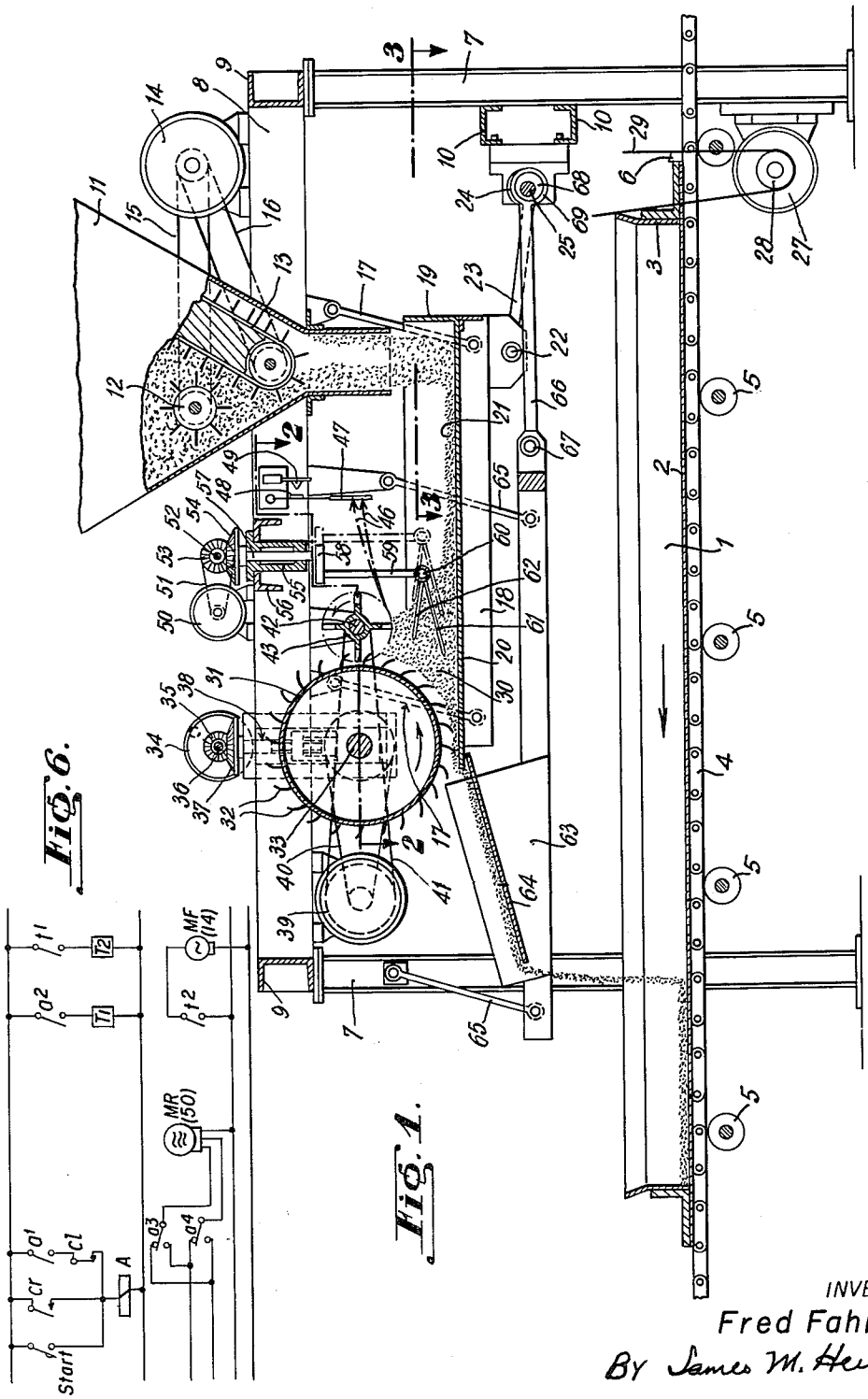


Fig. 1.

Fig. 6.

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Fig. 2.

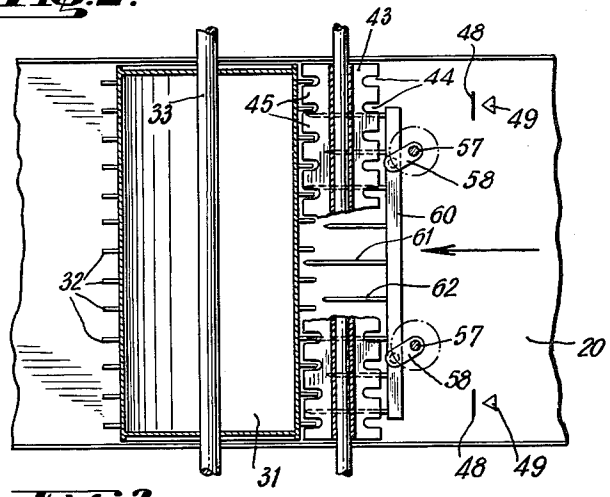


Fig. 3.

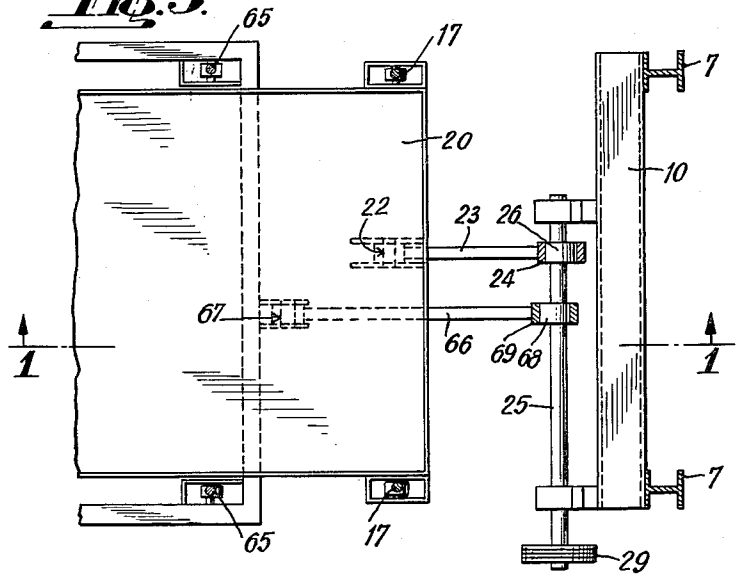


Fig. 4.

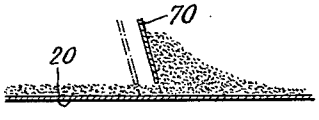
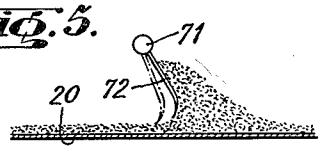


Fig. 5.



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United States Patent Office 2,980,290
Patented Apr. 18, 1961

2,980,290

METHOD AND DEVICE FOR THE FORMATION OF A STREAM OF PARTICLES OF CONSTANT LAYER THICKNESS

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Filed Jan. 16, 1957, Ser. No. 634,573

Claims priority, application Switzerland Jan. 16, 1956

21 Claims. (Cl. 222—1)

The object of the invention is a method as well as a device for the formation of a stream of particles of constant layer thickness, using a flat transport member for the conveyance of the particles and measuring means arranged above the transport member, which dam those particles which lie above the height corresponding to the desired layer thickness. It is in particular destined to be used for the formation of a stream of wood particles, such as shavings, chips, and similar particles such as those used in large quantities for the manufacture of hot pressed wood shaving boards.

In conformity with the method according to the invention, the height of the heap of particles lying in front of the measuring means is sensed in different places by several responsive devices distributed across the width of the transport member, and in addition, when the transversal distribution of the stream of particles is uneven these responsive devices start a distributing device by means of a control means, which device equalizes the differences in the dammed up height of the heap of particles.

The device for carrying out the method comprises, according to the invention, several responsive devices distributed across the width of the transport member in front of the measuring member in relation to the direction of conveyance of the transport member, and which become active when the height of the heap of particles lying in the region before them attains a determined height. For the rest the device according to the invention is provided with control means connected to the responsive devices and cooperating with a motor driven distributing device for equalizing the differences in the dammed up height of the heap of particles transversally to the longitudinal direction of the transport member.

The use of the principle of the damming measuring member, such as, for instance a rotary spiked drum, a rake having a translatory motion or of a similar device, in combination with a shaking chute or a conveyor belt is, in itself, not novel.

It is also known to arrange a device for the removal by suction or otherwise of the particles which have been heaped up in excess in the neighborhood of the damming or measuring member, which together with the transport member forms the so-called measuring gap which determines the thickness of the stream of particles formed. Apart from the fact that such devices absorb a relatively large amount of energy and are not particularly simple in construction, it is disadvantageous, when working with wood particles coated with bonding means, to cause particles returned to the container for the reserve of particles to mix with freshly coated particles, because this may prejudice the later bonding of the particles to form a solid body.

If, on understandable grounds, supplementary devices such as those which have just been described are eschewed, it may happen that the heap of particles dammed up in front of the measuring member is of very uneven height, as seen across the width of the transport member. This is

due to small inexactitudes in the system for dispensing the particles from the container containing the reserve of particles (for instance lack of parallelism of the dispensing rollers, etc.) or may for instance be caused by a practically imperceptible lateral inclination of the transport member. These faults add up, and it may then happen that in certain regions the height of the heap of particles is considerably in excess, whereas at other points there are not sufficient particles to fill up eventual gaps in the stream of particles which is arriving.

In the case of the invention these disadvantages are eliminated owing to the equalizing of the differences in the dammed up height of the heap of particles. The responsive devices may also be used advantageously for momentarily stopping a dispensing device of a container for the supply of particles arranged above the input end of the transport member, when the height of the mass of particles dammed up in front of the measuring member exceeds a certain value.

The equalization of the height of the heap of particles may in practice be obtained by local control of the stream of particles flowing from the container for the supply of particles onto the transport member, for instance by means of a swinging guiding plate. An advantageous solution is also obtained by providing a lateral distributing device directly influencing the heap of particles and equalizing the same and fitted with motor-driven tooth-like or other members.

The drawing shows a strewing or spreading device in which a stream of particles of constant layer thickness is formed with the help of a shaking chute and a spiked drum. The illustrated machine services to prepare fleeces of wood shavings in mould-frames. These fleeces of shavings are destined to be pressed in heated multi-layer presses to form wood shaving boards. In the drawing:

Fig. 1 shows a longitudinal cross-section along the line 1—1 in Fig. 3 of the machine.

Fig. 2 shows a cross-section along the line 2—2 of a part of the machine.

Fig. 3 shows a cross-section along the line 3—3 of another part of the machine.

Fig. 4 shows a cross-section of a varient of a detail of the machine.

Fig. 5 shows another variant of the same detail, and Fig. 6 discloses the control circuit.

In Fig. 1 of the drawing a mould-frame 1 is in the act of running past in the direction of the arrow beneath the strewing device described later on. This frame is essentially composed of a bottom plate 2 and of a frame part proper 3 which can be lifted off. The frame rests on conveyor chains 4 which are carried on rollers 5 or on continuous wooden supporting battens so as not to sag. The mould-frame 1 is drawn along by means of a stop 6. The machine rests on the floor by means of four vertical pillars 7. The whole frame of the machine is completed in addition by two longitudinal beams 8 resting on the pillars 7, two cross beams 9 and 56 and two U profiles 10. A conical bin to hold the reserve of shavings is fixed to the longitudinal beams 8 and inside this are arranged a spiked drum 12 and a spiked belt 13 for dispensing the shavings. These dispensing means are driven by an electric motor 14 with the help of driving belts 15 and 16.

A transport member, such as, a shaking or oscillating chute 18 surrounded on three sides by vertically projecting edges 19 is hung directly under the exit of the bin 11 by means of links 17. Other types of conventional flat transport members may be used; for example, a flight or air conveyor in a stationary trough, a belt conveyor of the solid web or screen type and with or without cauls, carriage on rails, etc. The bottom 20 of this shaking chute is practically horizontal. An electric motor 27 is provided to generate the vibratory motion required to

convey the mass of shavings 21 and drives a shaft 25 by means of a pulley 28 and a belt 29. An eccentric sheave 26 is secured to this shaft, so that during the rotation of the shaft 25 a driving rod 23 articulated in 22 and which encircles the eccentric sheave 26 by means of a ball bearing which has not been drawn is swung back and forth and reciprocates the suspended shaking chute 18, so that the mass of shavings dispensed by the bin 11 is conveyed towards a spiked drum 31 rotating in the direction of the arrow and forms a pile of shavings 30 up against this drum. It is easy to see in Fig. 1 that the shavings are constantly conveyed back by the spiked drum 31. The spikes 32 are bent backwards in relation to the direction of rotation of the drum. In this way it is less likely that the shavings should become jammed between the spikes. In addition, it is this measure which makes it possible for the spiked drum 31 to cooperate properly with a rotary combing member to be described later. The spiked drum 31 is mounted on a shaft 33, which is carried in two adjustable bearings. A hand wheel 34 serves to adjust the height of the drum 31. It is rigidly connected to a bevel gear 35 and to a shaft 36. The bevel gear 35 meshes with a further bevel gear 37 secured to a bolt 38 vertically mounted in bearings, whilst a further bevel gear driving a similar bolt is secured to the other end of this shaft. The two bolts of which one, 38, can be seen in Fig. 1 are provided with screw threads so that when they are simultaneously rotated in the same direction they raise or lower the bearings of the shaft 33 a predetermined amount. The parallelism of the gap between the points of the spikes and the bottom 20 of the shaking chute is thus ensured. A motor 39 drives the spiked drum 31 by means of a belt 40. Owing to the relatively large diameter of the drum, the speed of this drum need not be very high.

The spiked drum 31 rotating in a direction which is contrary to the direction of motion of the conveyed shavings thus dams the shavings, fills in gaps in the stream of shavings and in addition loosens the mass of shavings, so that a uniform stream of shavings of constant thickness flows under it. In this manner an exactly predetermined volume of shavings is released per unit of time. The measuring effect is particularly good owing to the bent back shape of the spikes 32. It is of course possible to mount the shaft 33 exactly above the delivery edge of the shaking chute 18. In certain cases however, it will be advantageous to set this shaft back somewhat towards the bin 11, or even to mount it a small distance in front of this edge.

If the level of the shavings 30 piled up against the spiked drum 31 were to rise higher than the level of the shaft 33, then the shavings would immediately be drawn up over the drum. The exact measuring effect of the spiked drum 31 would thus be rendered void. In order to prevent this, a level limiting drum 43, composed of four comb-like plates set at 90° from one another and provided with notches 44 (Fig. 2) is keyed to a shaft 42, which is driven by the motor 39 by means of a belt 41. The tooth-like projections 45 reach in between the spikes 32. The four plates of this wiping member 43 are set in rotation in the same sense as the spiked drum 31, so that the points 45 and the spikes 32 move in the opposite direction at the point where they move past one another. The level limiting drum 43 has a further task, which is to fling back the shavings lying above a certain height in the heap 30 in the direction of the arrows 46. In order to impart to the shavings which are flung back a sufficiently high speed, the ratio of multiplication between the motor 39 and the member 43 is chosen in such a manner that the latter rotates at very high speed. The shavings which are flung back as indicated, impinge in part on a swinging hanging plate 47, to which is secured a contact 48 belonging to an electric circuit which has not been shown in the drawing. A fixed contact 49 completes this to form a pair of contacts. Two such pairs of electric contact proximity switches are advantageously provided, one of them being placed on the left side and the other on the right side of the shaking chute 18. It is thus possible to determine on which side of the shaking chute the heap of shavings 30 first rises up to the level limiting drum 43.

There exists a possibility that, for some reason or other the bin 11 may dispense quantities of shavings which are not equal on both sides. In order to compensate such irregularities in the delivery of the shavings, the machine is fitted with the following device: A motor 50 drives, by means of a belt 51, a shaft 52 on which are keyed two bevel gears 53, of which only one, however, is visible in the drawing. Shafts 57, running in bushings 55 carried by a cross beam 56 are driven by means of bevel gears 54 and carry a foot 58 at their lower extremity. Two supports 59 are pivoted in the feet 58. They carry a rake 60 provided with a number of short spikes 62 and with several long spikes 61. The short spikes are parallel to each other and the long spikes are parallel. However, the short spikes are slightly inclined in an upwardly direction, while the long spikes are slightly inclined in a downwardly direction. When the motor 50 is running the rake 60 effects a translatory motion, indicated by dots and dashes, and this in one direction or the other, according to the manner in which the motor is switched on. In this way the heaped up shavings will be conveyed from the left to the right or vice versa.

A further shaking chute 63 the bottom 64 of which has a relatively considerable inclination is arranged to continue the shaking chute 18. This shaking chute, which serves to effect the strewing operation, is hung by means of links 65 and is driven by means of a connecting rod 66 which on the one end is articulated in 67 and on the other end closely encircles an eccentric sheave 68 mounted on the shaft 25 by means of a ring 69 and of a ball bearing which has not been shown. The two eccentric sheaves 26 and 68 are at 180° from one another, so that the forces of inertia of the two shaking chutes at least partially compensate one another.

In addition, the following is a description of the operation of the machine the construction of which has been described.

The shavings contained in the bin 11 are delivered from its lower end and strewn or spread onto the shaking chute 18 as long as the motor 14 is running and driving the spiked drum 12 as well as the spiked belt 13. Owing to the vibratory motion the shavings are conveyed towards the delivery edge. As has already been mentioned a relatively even layer of shavings of constant thickness passes through under the spiked drum 31. This mass of shavings now falls onto the inclined bottom 64 of the flat transport member or strewing shaking chute 63. The task of this shaking chute is first of all to accelerate the conveyance of the shavings issuing from the calibrating gap (gap between the spiked drum 31 and the bottom 20 of the shaking chute). The thickness of the layer of shavings thus becomes less, which favors the elimination of strewing errors. In addition, owing to the higher speed of conveyance, eventually remaining bundles of shavings are torn apart on the shaking chute and finally any predominant direction of the shavings is eliminated, because the shavings skip about amongst themselves. The shavings fall from the delivery edge of the strewing shaking chute 63 in a mould-frame 1. The latter could also be replaced by a conveyor belt.

If the heap of shavings 30 situated on one side of the shaking trough now happens to project within the trajectory of the outer edges of the comb plates of the level limiting drum 43, then there will be shavings which will be flung back against the plate 47. Let us suppose that this happens on the rear side of the shaking chute 18 as viewed in Fig. 1. The plate, which hangs freely will be swung towards the rear so that the contact 48 comes to rest against the contact 49 and closes a circuit which

is not described in detail, for instance the circuit of a control relay. The closing of the pair of contacts indicated in the upper part of Fig. 2 causes the motor **50** to be switched on in such a fashion that the rake **60** now begins to convey shavings to the other side. It effects, for this purpose, a translatory circular motion until the opposite pair of contacts closes, with the result that the direction of rotation of the motor **50** is reversed anew.

The contacts **48** and **49** can also be advantageously used to control the feed delivery motor **14**. A timing device could for instance be provided for this purpose, which starts the motor **14** when the time interval between two reversals of the motor **50** exceeds a predetermined value, i.e. when the heap of shavings **30** piled up against the spiked drum **31** has diminished too much. The motor **14** is switched off again after a given time interval, for instance under the control of another timing element, which begins to function after the reversing contacts have been actuated the following time.

Fig. 4 is a partial view of a cross-section of a variant of the device, which, instead of the spiked drum, is provided with a plate **70** cooperating with driving means generating a translatory motion and which is moved over the bottom **20** of the shaking chute. In the case of Fig. 5 the shavings are dammed back by means of a rake **72** swinging about an axle **71**. The speed of the swinging motion of this damming member must naturally be very great in order to ensure the regularity of the thickness of the layer of the stream of shavings issuing from beneath it.

It would obviously be possible—and in some cases even more advantageous—to replace the spiked drum by an endless spiked belt. In place of the equalizing means comprising rakes with a translatory motion it would also be possible to use means which distribute the supply from the container **11** unevenly across the width of the shaking chute **18** according to the momentary requirements. For this purpose the feed device and the distributing device could be combined, and use be made of a feed spiked drum, which is divided along its length, each individual section of the drum being mounted on the same shaft but being driven independently. Finally, it appears advantageous in this respect, to control the stream of particles flowing from the container **11** by means of one or more guiding plates, suspended so as to be able to swing, so that the shaking chute **18** is unevenly loaded across its width. The control of such a guiding plate, which owing to the simplicity of its principle has not been shown in the drawing, may in practice be effected by means of a piston connected to it and moved under the action of pressure means, which in its turn is controlled in a known manner by means of electro-magnetically controlled valves.

As to the control circuit containing both contacts which serve to reverse the direction of rotation of motor **50** and the timing relay circuit comprised in the first mentioned circuit, they are shown on the diagram in Fig. 6.

The diagram in Fig. 6 is very simple. However, the circuit shown can only work when contact *cr* is normally opened and contact *cl* is normally closed.

If the height of the heap of chips exceeds a predetermined value on the right side, contact *cr* is closed, whereas if this height is exceeding said value on the left side, contact *cl* is opened. The process is the following: After contact "Start" is closed, relay A is energized and a self-holding circuit is established over contacts *a1* and *cl*. The direction of motor MR is reversed by a transfer of contacts *a3*—*a4* and time-lag relay **T1** is switched on, because of the closing of contact *a2*. When the heap has reached the predetermined height, contact *cl* opens, relay A drops out and contacts *a3* and *a4* transfer to the other position, so that motor MR starts turning in the other direction. The next pick up of relay A is caused by the closing of contact *cr*. Relay **T1** cannot close its contact, *t1*, if the closing time of contact *a2* has not exceeded a certain duration. If such is the case, time-lag relay **T2** picks up and keeps contact *t2* closed for a predetermined time. Fig. 6 is very simple, but the embodiment described in the patent application in Figs. 1–5 contains two closing contacts **48** and **49**, whereas Fig. 6 contains a closing contact *cr* and an opening contact *c2*.

What I claim is:

1. An apparatus for the formation of a stream of particles of constant layer thickness comprising a flat transport member and a measuring member, several sensing responsive devices distributed across the width of said transport member in front of said measuring member in relation to the direction of conveyance of the transport member, said responsive devices constructed to become active when the height of the heap of particles lying in the region attains a predetermined height, control means connected to the responsive devices and a motor-driven distributing device cooperating with the latter for equalizing the differences in the dammed up height of the heap of particles transversally to the longitudinal direction of the transport member.

2. An apparatus according to claim 1, characterized in that a laterally equalizing device the motion of which is reversible is made use of as distributing device, so that according to the momentary position of the control means, particles are moved from the left hand towards the right hand longitudinal side of the transport member or vice-versa.

3. An apparatus according to claim 2, characterized in that the laterally equalizing device comprises a rake having a translatory and circular motion, the direction of this motion being reversible.

4. An apparatus according to claim 1, characterized in that the distributing means provided consist in means which are able to cause a differential feed of the particles to the transport member across the width of this transport member, and this in dependence of the momentary position of the control means.

5. An apparatus according to claim 1, characterized in that a guiding plate is arranged between the transport member and a container for the supply of particles arranged above the input end of the same, which guiding plate can be swung to one side or to the other under the influence of the control means.

6. An apparatus according to claim 1, characterized in that a guiding plate is connected to a piston, which can be moved under the action of pressure means to deposit particles on a particular transverse section of a transport member.

7. An apparatus according to claim 1, characterized in that the measuring means comprise a continuously moving surface provided with spikes which are bent backwards, in relation to the incident stream of particles.

8. An apparatus according to claim 1, characterized by the said measuring means being provided with spikes, wiping members provided with slots which by means of driving means can be set in rotation about an axis which is perpendicular to the longitudinal direction of the slots, and which reach in between the spikes of the measuring means in such a fashion that the transport of particles over the measuring means is prevented.

9. An apparatus according to claim 1 wherein said control means comprises two contacts placed on different sides of the longitudinal middle axis of the transport member and which change their state of contact when the height of the mass of particles on the same side attains a determined height, and characterized further by a control circuit containing the two contacts which serves to reverse the direction of motion of an electric motor driving the distributing device.

10. An apparatus according to claim 1, characterized in that said control means comprises two contacts situated in front of the wiping members in relation to the direction of conveyance of the transport member and arranged

in such a fashion that they are actuated by the particles flung back by the wiping members.

11. An apparatus according to claim 1, characterized by a timing relay in the said control means circuit which momentarily switches on a feed motor of a container for the supply of particles when the time interval between actuations of the two contacts exceeds a determined value.

12. An apparatus as set forth in claim 1 in which said flat transport member is a flat type conveying mechanism.

13. A method for the formation of a stream of particles of constant layer thickness, in particular of wood particles such as shavings, chips and similar particles, comprising using a flat transport member and measuring means arranged above the transport member, damming those particles which lie above the height corresponding to the desired layer thickness, sensing in different places the height of the heap of particles lying in front of the measuring means and across the width of the transport member, and equalizing the difference in the dammed-up height of the heap of particles when the transversal distribution of the stream of particles becomes uneven.

14. A method according to claim 13, characterized by releasing several responsive sensing members causes the supply of particles to the measuring member to be momentarily entirely arrested.

15. A method for the formation of a stream of particles of constant layer thickness over the width of the stream, in particular of wood particles such as shavings, chips and similar particles, conveying the particles constantly in a direction towards a metering point arranged above said stream, damming those particles which lie above the height corresponding to the desired layer thickness, checking at the same time and in different places across the width of the stream the height of the heap of particles lying in front of the metering point and equalizing the difference in the dammed up height of the heap of particles when the transversal distribution of the stream of particles is uneven at these level checking points.

16. An apparatus for the formation of a stream of particles of constant layer thickness comprising a flat transport member, a thickness regulating drum positioned above and adjacent to said flat transport member and having projecting elements thereon, a level limiting rotatable element positioned to cooperate with said drum, and means above said flat transport member and in front of said drum and associated with said drum and said rotatable element for placing particles transversely across said transport member so as to decrease the thickness of said stream of particles at certain points on said transport member and to increase the thickness at other points and thereby substantially equalize the thickness of the particles across the transport member.

17. An apparatus as set forth in claim 1, said sensing responsive devices being mechanical, and electric proximity switches distributed across said flat transport member actuated by said sensing responsive devices.

18. An apparatus as set forth in claim 16 in which said flat transport member comprises an oscillating chute.

19. A device as set forth in claim 18 in which said means for placing particles transversely across said oscillating chute comprise electrical contact members, said electrical contact members operatively connected to an oscillating bar having fingers movable generally crosswise of said chute whereby when said fingers are operating said particles are moved transversely to the right or to the left from an area of greater layer thickness to an area of thinner layer thickness so that the thickness across the layer will be equalized.

20. A method according to claim 13 comprising the step of moving particles laterally in front of the dam in relation to the direction of conveyance so that the height of the heap of particles lying in front of the measuring member is equalized.

21. A method according to claim 13 comprising feeding particles from a container for the reserve of particles arranged above the transport member, controlling said feeding in such a manner that the stream of particles flowing on to the input end of the transport is uneven, and subsequently equalizing the uneven height, as seen across the width of the transport member, of the heap of dammed up particles lying in front of the measuring member.

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