DEVICE FOR FEEDING GRANULAR MATERIAL

Filed March 14, 1960 3 Sheets-Sheet 1

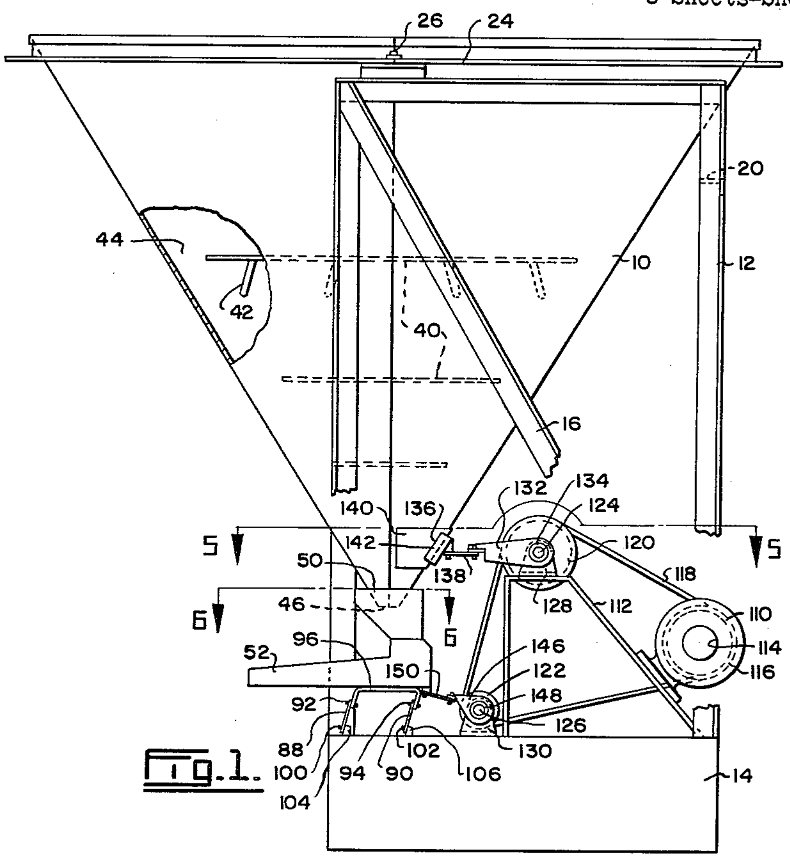

Fig. 1.

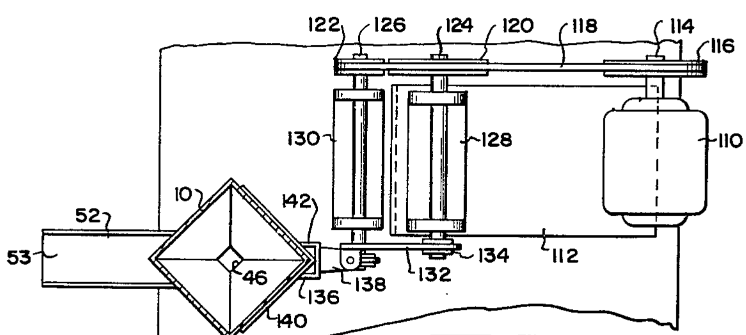

Fig. 5.

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DEVICE FOR FEEDING GRANULAR MATERIAL

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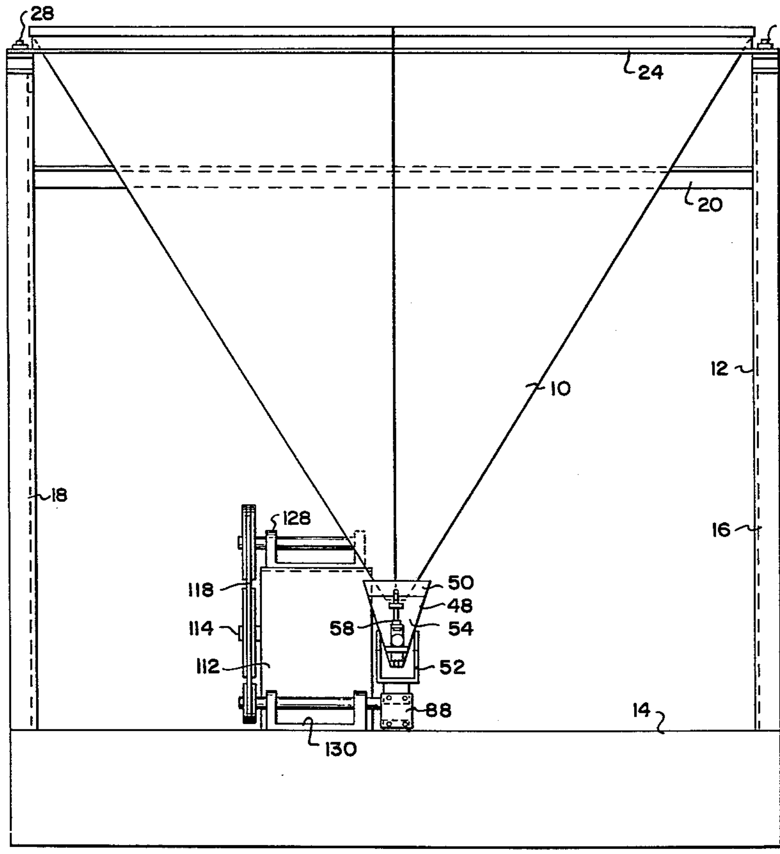

Fig. 2.

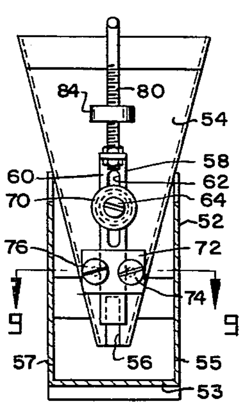

Fig. 8.

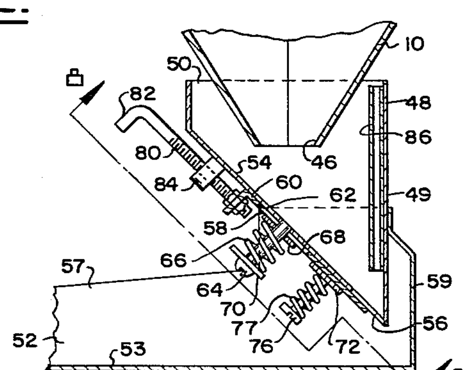

Fig. 7.

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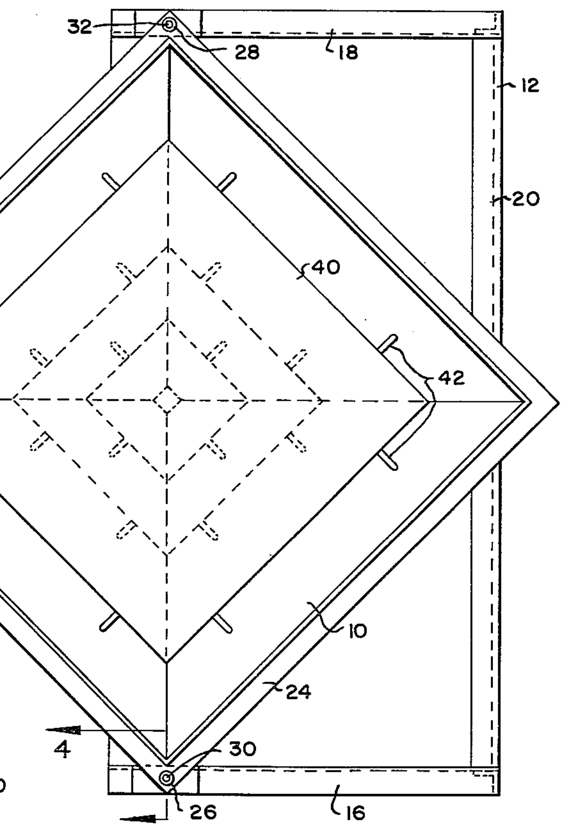

Fig. 3.

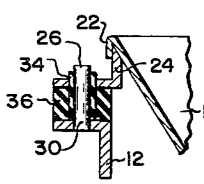

Fig. 4.

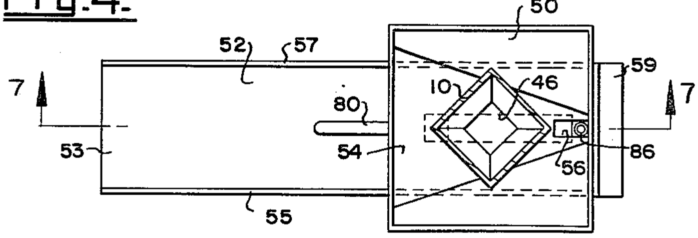

Fig. 6.

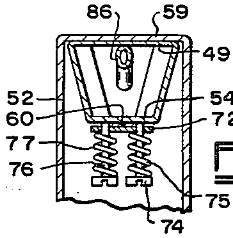

Fig. 9.

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DEVICE FOR FEEDING GRANULAR MATERIAL

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12 Claims. (Cl. 222—161)

This invention relates to a device for feeding granular material, in particular, to a device for feeding diatomaceous earth to a filter to aid in the removal of suspended solids from a liquid.

One application of the invention is to feed a filter aid material to a swimming pool filter to reduce the turbility of the water in order to meet the rigid public health standard requirements. The type of filter aid utilized in these filters varies in accordance with the specific problems encountered but one of the efficacious and universally applicable of the filter aid materials is diatomaceous earth. This material has the drawback, however, that it is a difficult material to handle particularly at the low flow rates required for body feeding a swimming pool filter wherein flow rates in the order of from 8 ozs. to 3 lbs. per hour are common for pools from 60,000 to 360,000 gallons capacity. Because of the difficulties experienced hitherto in supplying and controlling dry diatomaceous earth in small quantities, it has been the common practice to use wet feeders. In a wet feeder the diatomaceous earth is mixed in a thin slurry and the slurry metered and pumped at the required rate. Wet feeders, however, are both expensive and unreliable. The importance of reliable and accurately controlled feed rates becomes evident when it is realized that inaccurate control can easily treble the amount of labour required to service a given filter and result in a great wastage of the diatomaceous earth thereby increasing the cost of servicing the filter.

It is therefore a primary object of this invention to provide a device that will feed granular material particularly diatomaceous earth continuously at a predetermined rate and that will maintain the preset rate of flow within acceptable limits.

A further object of the invention is to provide a device for feeding diatomaceous earth which is relatively simple and inexpensive to manufacture and which is highly efficient in operation.

Another object of the invention is to provide a device for feeding diatomaceous earth which is rugged in construction and durable in use.

Yet another object of the invention is to provide a device for feeding granular materials and particularly diatomaceous earth by means of which the material may be evenly and properly fed without compacting or bridging within the feeder.

In accordance with these objects, the present invention contemplates a material feeding device comprising a base; a storage hopper for containing the material in bulk form, said storage hopper resiliently mounted in a support secured to said base; a control hopper having an open top spaced below the outlet of the storage hopper and a discharge outlet communicating with the delivery trough, said delivery trough connected to said control hopper and resiliently connected to said base; means associated with said discharge outlet for controlling the quantity of material fed from said control hopper to said delivery trough; and means for simultaneously vibrating said storage hopper and said delivery trough thereby to feed material from said hopper through said control hopper to said delivery trough from where it is discharged, the rate of discharge of material being controlled by the size of said dicharge outlet and by the frequency and amplitude of the vibrations of the storage hopper and delivery trough respectively.

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Other features of the invention will be described hereinafter and referred to in the appended claims.

The invention will be further described in connection with the accompanying drawings which show by way of example one embodiment of the invention and in which—

FIGURE 1 is a side elevation partly in section,

FIGURE 2 is a front elevational view,

FIGURE 3 is a top plan view,

FIGURE 4 is a sectional view on the line 4—4 of FIGURE 3,

FIGURE 5 is a sectional view on the line 5—5 of FIGURE 1,

FIGURE 6 is a sectional view on the line 6—6 of FIGURE 1,

FIGURE 7 is a view on the line 7—7 of FIGURE 6,

FIGURE 8 is a front elevation partly in section showing a detail of the adjustable outlet means and the delivery trough, and

FIGURE 9 is a sectional view on the line 9—9 of FIGURE 8.

Referring to the drawings, **10** designates a storage hopper pivotally connected to a rigid frame **12** which is mounted on a suitable base or foundation **14**.

The frame **12** comprises a pair of spaced apart braced rectangular frameworks **16** and **18** secured to the base **14** and interconnected by a horizontal strut **20**. As shown the frame **12** is fabricated entirely from angle section material such as mild steel joined together in any suitable manner as, for example, by welding.

The storage hopper **10** is of generally frustro pyramidal shape mounted base uppermost in the frame **12** and has its upper peripheral edge folded over as at **22** so as to form a snug fit around a rectangular collar **24** which circumscribes the upper edge of storage hopper **10**. The collar **24** which is formed of angle section bar stock is welded to hopper **10** or may be secured thereto in any other suitable manner and is pivotally connected at diagonally opposed corners **26** and **28** to the frame **12**. To this end, studs **30** and **32** are welded to the upper face of frame **12** and suitable holes are drilled in the diagonally opposed corners **26** and **28** of collar **24**. A rubber sleeve **34** is fitted around each of studs **30** and **32** and a rubber washer **36** is inserted between the mating faces of collar **24** and frame **12**. The storage hopper **10** is thus resiliently cradled base uppermost in the frame **12** and pivotally supported thereby.

A series of spaced apart horizontally disposed support plates **40** is mounted within the storage hopper **10**. The plates **40** are mounted on bracket **42** secured to the inner walls of storage hopper **10** and are positioned so as to leave a space between the edges thereof and the inner walls of storage hopper **10** thereby providing paths for the material to move progressively from one plate to the next below as the storage hopper empties. One of the main functions of these plates is to support the weight of material above it. The plates **40** are positioned within the hopper **10** in such manner that there is no large or vertical column of material in any one portion of the storage hopper. The use of these support plates **40** permits the use of a storage hopper having a reasonable storage capacity and at the same time the material behaves as if it was in a shallow hopper and does not compact or bridge.

The lower edge or periphery of the discharge mouth **46** of storage hopper **10** projects downwardly to within the upper edge or periphery of the inlet mouth **50** of a control hopper **48** which has a delivery trough **52** connected thereto or integrally formed therewith. The control hopper **48** is provided with an inclined base **54** provided with a slot **56** which forms a discharge outlet for control hopper **48**. The delivery trough **52** is formed with a base **53**, side walls 55 and 57, and an end wall 59 which is secured to the wall 49 of hopper 48. The outlet slot 56 for control hopper 48 is provided with an adjustable gate indicated generally at 58 which enables the volume rate of flow of material from control hopper 48 to be varied.

The adjustable gate indicated generally by the reference 58 consists of an elongated plate 60 having a width greater than that of the outlet slot 56 and provided with a slot 62. A pin 64 having a spring 66 sandwiched between two washers 68 and 70 threaded thereon is passed through the slot 62 and secured to base 54 of control hopper 48. A strap 72 is bridged over the plate 60 and is located by pins 74 and 76 which are secured to the base 54 of control hopper 48. Pins 74 and 76 also act as guides for plate 60. The pins 74 and 76 carry springs 75 and 77 respectively which springs bear on opposite ends of strap 72 and are effective to cause strap 72 to urge plate 60 against the base 54 of control hopper 48. A lead screw 80 provided at one end with a handle portion 82 is threaded through an internally threaded lug 84 secured to the underside of base 54 of control hopper 48 and rotatably coupled at its other end to plate 60. With this arrangement, rotation of the lead screw 80 is effective to move the plate 60 in its longitudinal axial direction thereby to vary the effective area of the discharge slot 56 in control hopper 48.

A tube 86 is positioned within control hopper 48 and extends part way down the wall 49 thereof to a position adjacent the discharge slot 56. The tube 86 contributes to the accuracy of the flow control and the reduction of dust by providing a separate passage for the entrance and exit of air thereby eliminating the undesirable puffing action which would normally occur upon rapid movement of the material towards and away from the walls of the control hopper 48.

The delivery trough 52 is supported by leaf springs 88 and 90 which are secured at their upper ends by bolts 92 and 94 to a bracket 96 fast on the base 53 of trough 52. At their lower ends the springs 88 and 90 are secured by bolts 100 and 102 to lugs 104 and 106 respectively mounted on the base 14. The springs 88 and 90 are arranged so that movement of the trough upon flexing of the springs causes the trough to be lifted slightly during its movement in the desired direction of motion of the material whilst when the springs flex in the opposite direction the trough moves backwardly and downwardly.

The storage hopper and the delivery trough are individually vibrated through their connections to a motor 110. The motor 110 is mounted on the stand 112 which is secured to the base support 14. The shaft 114 of motor 110 is provided with a pulley 116 and a belt 118 is passed around pulley 116 and pulleys 120 and 122 which are fast on shafts 124 and 126 respectively. The shafts 124 and 126 are rotatably mounted in brackets 128 and 130 respectively which are secured to the stand 112. A connecting rod 132 is coupled at one end to an eccentric 134 mounted on the free end of shaft 124 and is connected at its other end to bracket 136 secured to the storage hopper 10 adjacent the discharge end thereof by means of a flexible coupling 138. The bracket 136 consists of a V-shaped member 140 which is secured to adjacent walls of the storage hopper 10 and serves as a stiffener therefor. A lug 142 integral with member 140 is connected by means of a bolt to the flexible coupling 138. Another connecting rod 146 is coupled at one end to an eccentric 148 mounted on shaft 126 and at its other end to a flexible coupling 150 which is secured to the delivery trough 52. The throw of eccentric 134 is made greater than that of eccentric 148. Thus, for example, the throw of eccentric 134 may be 1/16" whilst that of eccentric 148 is 1/32". In this manner, therefore, the amplitude of vibration imparted to storage hopper 10 is greater than that imparted to the control hopper 48 and delivery trough 52. The diameter of pulley 122 is, however, relatively small compared to that of pulley 120 and consequently, the frequency of the vibration of delivery trough 52 is considerably higher than that of storage hopper 10.

In operation, with the gate mechanism 58 adjusted in accordance with the desired volume rate of flow, the material is moved from the storage hopper 10 into control hopper 48 in a relatively heavy and slow moving stream due to the relatively low frequency of vibration of the storage hopper 10. The material on entering the control hopper 48 is subjected to a more vigorous vibratory movement and passes through the discharge outlet 56 into the delivery trough 52 from where it is discharged in the form of a relatively thin and fast moving stream. In this manner the maximum volume rate of flow of material from the control hopper 48 may be regulated by the gate mechanism 58 whilst the vibratory movement imparted to the storage hopper 10 and the control hopper 48 delivery trough assembly facilitates the movement of the material through the device in a continuous and even stream without any piling up of material at any point within the feeder.

It will be seen from the foregoing description of my invention that a material feeding device constructed in accordance therewith enables granular material and in particular diatomaceous earth to be fed to a filter in an even manner and at a predetermined rate of flow which is easily regulated in accordance with requirements. Furthermore, the feed is continuously maintained within the desired limits since no compacting or bridging of the material occurs within the feeder.

What I claim as my invention is:

1. In a material feeding device, a base, a storage hopper having an outlet for containing the material in bulk form, said storage hopper resiliently mounted in a support secured to said base; a control hopper having an open top spaced below the outlet of the storage hopper; a delivery trough connected to said control hopper and resiliently connected to said base; an adjustable gate on said control hopper providing a variable feed opening for discharge of material from the control hopper into the delivery trough; means for imparting vibratory movement of predetermined amplitude and frequency to said storage hopper, and means for imparting to said control hopper and delivery trough vibratory movement of lesser amplitude and greater frequency than the amplitude and frequency respectively of the storage hopper vibratory movement imparting means, the rate of discharge of material from the delivery trough being determined by the setting of said adjustable gate and by the frequency and amplitude of the vibratory movement imparted to said storage hopper and to said control hopper and delivery trough respectively.

2. A material feeding device as claimed in claim 1 wherein said delivery trough is connected to said base by means of flexible leaf springs.

3. In a material feeding device, a base, a storage hopper having an outlet for containing the material in bulk form, said storage hopper resiliently mounted in a framework secured to said base; a control hopper having an open top spaced below the discharge outlet of the storage hopper and having a discharge outlet opening into a delivery trough, said delivery trough secured to said control hopper and resiliently connected to said base; means for controlling the size of said discharge outlet of the control hopper to provide a variable feed opening for discharge of material from the control hopper into the delivery trough; and means for vibrating said storage hopper at a predetermined amplitude and frequency, and means for vibrating said delivery trough at a lesser amplitude and greater frequency than the amplitude and frequency respectively of the storage hopper to feed material from said storage hopper through said control hopper to said delivery trough from where it is discharged, the rate of discharge of material being controlled by the size of said discharge outlet and the frequency and amplitude of the

vibrations of the storage hopper and delivery trough respectively.

4. A material feeding device as claimed in claim 3 wherein said vibrating means for the storage hopper and the trough comprises a power unit mounted on said base; a shaft rotatably mounted on said frame, a pulley fixedly mounted on said shaft, an eccentric mounted on said shaft, and a connecting rod flexibly coupled at one end to the storage hopper and coupled at its other end to said eccentric; a second shaft rotatably mounted on said frame, a second pulley fixedly mounted on said second shaft, a second eccentric mounted on said second shaft, and a second connecting rod flexibly coupled at one end to the delivery trough and coupled at its other end to said second eccentric; and transmission means connecting the power unit to each of said pulleys for rotating said shafts, thereby to vibrate the storage hopper and the delivery trough through their associated connecting rods and eccentrics.

5. A material feeding device as claimed in claim 4 wherein the throw of the first-mentioned eccentric is greater than the throw of the second eccentric.

6. A material feeding device as claimed in claim 4 wherein the diameter of the first-mentioned pulley is smaller than that of the second pulley.

7. In a material feeding device, a base; a storage hopper having an outlet resiliently mounted in a support secured to said base; a control hopper having an inlet opening underlying the outlet of said storage hopper and having a discharge outlet communicating with a delivery trough, said trough connected with said control hopper and resiliently connected to the base; means for adjusting the size of said control hopper discharge outlet thereby to control the rate of flow of material from said control hopper to said delivery trough; a tube, at least one end of which is positioned within the control hopper and is adjacent the outlet of said control hopper and its other end communicating with the atmosphere; means for imparting vibratory movement at a predetermined amplitude and frequency to said storage hopper, and means for imparting to said delivery trough vibratory movement of lesser amplitude and greater frequency than the amplitude and frequency respectively of the storage hopper vibratory movement imparting means to feed material from said storage hopper through said control hopper and to said delivery trough from where it is discharged, the rate of discharge of material from the delivery trough being determined by the size of said discharge outlet and by the frequency and amplitude of the vibratory movement imparted to the storage hopper and the delivery trough respectively.

8. In a material feeding device, a base; a storage hopper having an inlet and an outlet resiliently mounted in a support secured to said base; a plurality of spaced apart horizontally disposed support plates mounted on the inner side walls of said storage hopper; a control hopper mounted with its inlet underlying the outlet of said storage hopper and having an inclined base provided with a discharge outlet therein; a delivery trough secured to said control hopper and resiliently connected to said base; means at the control hopper discharge outlet for controlling the quantity of material fed from said control hopper to said delivery trough; a tube, at least one end of which is positioned within the control hopper and is adjacent the outlet of said control hopper and its other end communicating with the atmosphere; and means for imparting independent vibratory movement to said storage hopper and said delivery trough to feed material from said storage hopper through said control hopper and into said delivery trough from where it is discharged, the rate of discharge of material from the delivery trough being determined by the outlet controlling means of the control hopper and by the frequency and amplitude of the vibratory movement imparted to said storage hopper and to said control hopper and delivery trough respectively.

9. In a material feeding device, a base; a rigid support frame; a funnel-shaped storage hopper for containing the material in bulk form pivotally mounted base uppermost on said support frame, said storage hopper provided at its apex with an outlet and having a plurality of spaced apart substantially horizontally disposed plates mounted on the inner wall thereof; a control hopper having an open top positioned below the outlet of said storage hopper and having a discharge outlet in the base thereof; a delivery trough secured to said control hopper and resiliently connected to said base by means of flexible leaf springs; means for adjusting the size of said discharge outlet thereby to control the rate of flow of material from said control hopper to said delivery trough; means for vibrating the storage hopper at a predetermined amplitude and frequency, and means for vibrating said control hopper and delivery trough at a lesser amplitude and greater frequency than the amplitude and frequency respectively of said control hopper and delivery trough.

10. A material feeding device as claimed in claim 9 wherein said vibrating means for the storage hopper and the trough comprises a power unit mounted on said base; a shaft rotatably mounted on said frame, a pulley fixedly mounted on said shaft, an eccentric mounted on said shaft, and a connecting rod flexibly coupled at one end to the storage hopper and coupled at its other end to said eccentric; a second shaft rotatably mounted on said frame, a second pulley fixedly mounted on said second shaft, a second eccentric mounted on said second shaft, and a second connecting rod flexibly coupled at one end to the delivery trough and coupled at its other end to said second eccentric; and transmission means connecting the power unit to each of said pulleys for rotating said shafts, thereby to vibrate the storage hopper and the delivery trough through their associated connecting rods and eccentrics.

11. A material feeding device as claimed in claim 10 wherein the throw of the first-mentioned eccentric is greater than the throw of the second eccentric.

12. A material feeding device as claimed in claim 10 wherein the diameter of the first-mentioned pulley is smaller than that of the second pulley.

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