Dec. 13, 1960 J. ABONNENC 2,964,359

FEED ADJUSTING MEANS FOR HAMMER MILLS, PNEUMATIC CONVEYORS AND THE LIKE SUCTION-OPERATED MEANS

Filed Oct. 4, 1955 3 Sheets-Sheet 1

Fig. 1

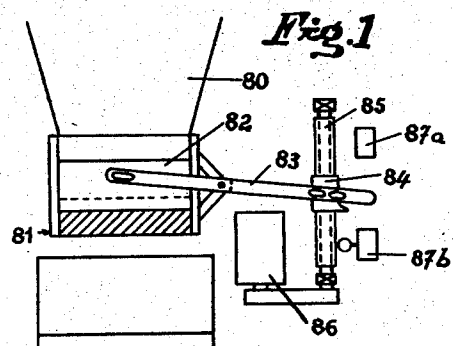
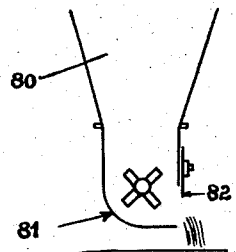


Fig. 2



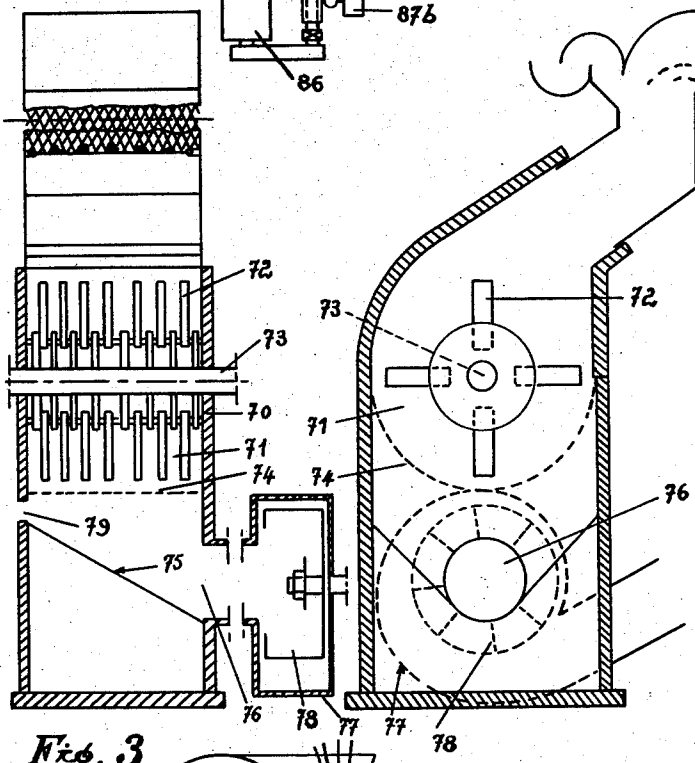
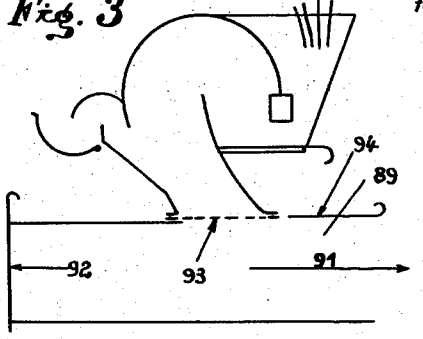


Fig. 3



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Filed Oct. 4, 1955 3 Sheets-Sheet 2

Fig. 8

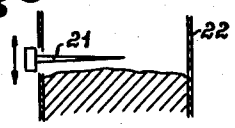


Fig. 10

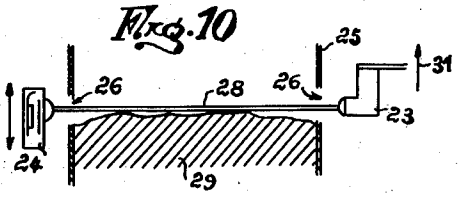


Fig. 9

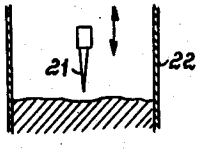


Fig. 11

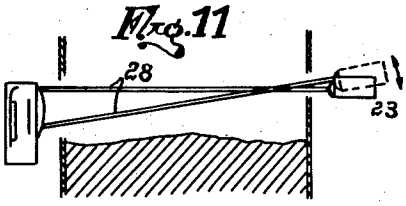


Fig. 12

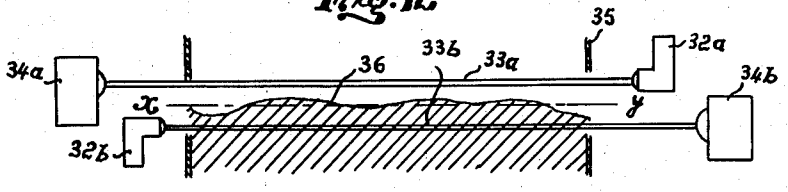


Fig. 13

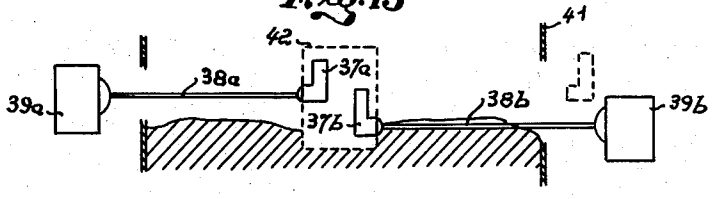
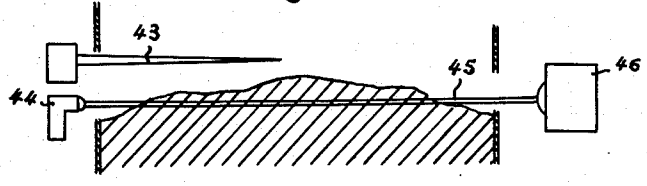


Fig. 14



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FEED ADJUSTING MEANS FOR HAMMER MILLS, PNEUMATIC CONVEYORS AND THE LIKE SUCTION-OPERATED MEANS

Filed Oct. 4, 1955 3 Sheets-Sheet 3

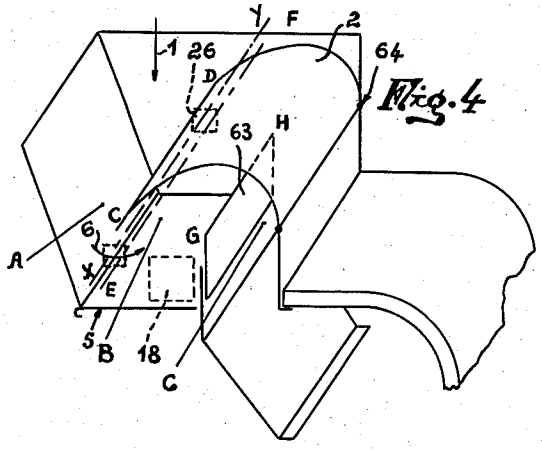


Fig. 4

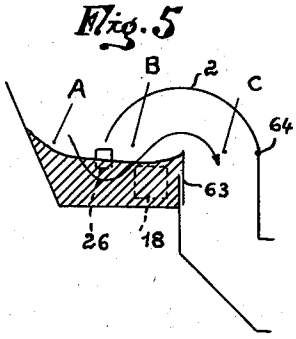


Fig. 5

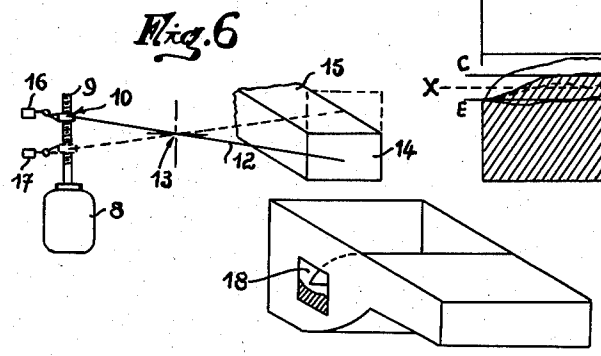


Fig. 6

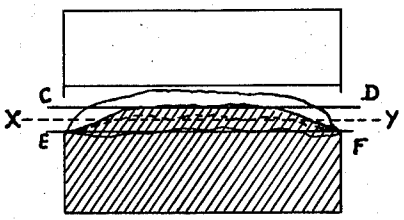


Fig. 7

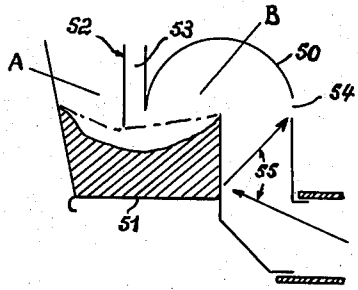


Fig. 15

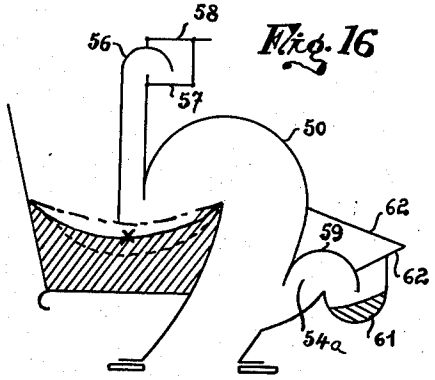


Fig. 16

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FEED ADJUSTING MEANS FOR HAMMER MILLS, PNEUMATIC CONVEYORS AND THE LIKE SUCTION-OPERATED MEANS

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Filed Oct. 4, 1955, Ser. No. 538,499

Claims priority, application France Oct. 15, 1954

7 Claims. (Cl. 302—36)

Percussion crushers and hammer mills require for the removal of the material crushed therein a powerful suction adapted to empty the crushing chamber and to convey the crushed material further on.

The capacity of production of such machines is highly variable. It depends on the size of the openings in the grids and on the nature of the materials to be crushed, the said materials differing as to their specific weight, hardness and contents of cellulose or the like fibres.

The maximum efficiency of a crusher is reached at the threshold of clogging. This clogging occurs when the suction is no longer sufficient for the removal and the conveyance of the crushed material. When one operates beyond this threshold, in the case of an excess amount of material entering the apparatus, the suction is cut off entirely or nearly so. This leads to a very large demand for driving power which, in the case of a crusher controlled by an electric motor, may produce overload operation of the circuit-breaker controlling the circuit feeding the motor. It is then necessary to unclog the crusher by hand together with the suction means, before resuming operation. In practice, the attendants or the automatic means controlling the input of material into the crusher operate with a high margin of safety so as to avoid a clogging, but the yield obtained is then lower than that actually obtainable using the full efficiency of the machine.

My invention has for its object feed-adjusting means applicable to machines operating under suction and chiefly to hammer mills and pneumatic conveyors, and adapted to feed the machine in a uniform and constant manner at the limit of its capacity before clogging, whatever may be the material to be crushed, provided it is of a pulverulent nature and capable of being conveyed pneumatically.

To this end, the material to be crushed or conveyed is fed into a rectangular opening located in a horizontal plane inside a casing out of which the said material cannot flow through gravity while it is sucked out of the said casing through another rectangular opening located at the same level or at a level above that of the first mentioned opening, the said two openings being separated from one another by a partition, so that the suction acts along a curvilinear path assuming the shape of a syphon and the lowermost point of which registers vertically with the said partition at the level of a line parallel to and in proximity with the lower ridge of the said wall or partition, said line defining the limit beyond which the machine becomes clogged and corresponding to the maximum possible yield of the machine.

To obtain this automatic regulation of the feed of the machine for continuous operation at maximum yield, the ridge of the partition separating the two openings serving for the feeding and the suction respectively, forms the control member operating through the agency

of one or more level detectors. The said detectors, which may be advantageously of an electronic type, hold the lowermost point of the suction curve near the threshold of clogging by acting on the feed of the machine, the driving motor of which remains continuously operative.

The feed of the machine may be adjusted gradually through a modification of the cross-section of the passage provided for the material or else through a modification of the speed of flow of said material.

Thus, in a preferred embodiment, the detector or detectors carried by the partition separating the two openings in the machine control the operation of an electric motor which produces, through the agency of a worm and of a lever system, the opening or the closing of a gate inserted in the feed pipe.

Although the adjusting means, according to my invention, may include only a maximum or a minimum detector, it is preferable to provide it with both types of detector.

In a preferred embodiment, I may utilize to a maximum and minimum detector comprising two light beams extending across the syphon-shaped curve and produced by two sources of light arranged laterally at one side of the syphon so as to impinge on corresponding photocells on the opposite side of the said syphon, the vertical spacing between the two sources of light being adjustable, so as to allow for modification of the difference between the maximum and the minimum permissible levels of the material.

In a further embodiment, the maximum and minimum detector may be constituted by a detector of the presence of the material associated with a beam produced by a source of light and impinging on a photocell, the said detector and said beam being vertically dimensioned to define, respectively the maximum limits and the minimum, or conversely.

According to a still further feature of my invention, the adjusting means include at least one additional air intake formed at a point of the flow path feeding the material to be crushed into the input of the crusher so as to allow a suction to be exerted on the material in the case of a temporary fortuitous clogging of the actual adjusting means. This air intake is constituted preferably by an opening formed in one or in both of the two side walls of the adjusting means at a level such that its center is located substantially in register with the line defining the threshold of clogging.

The additional air intake may also be formed by an elongated slot in the wall of the adjusting means on the downstream side of the syphon or else, by a channel opening ahead of and underneath the partition separating the two openings corresponding respectively to the admission and to the suction of the material through the adjusting means while a flap engaging the said channel allows adjusting not only the flow rate of the additional air but also the average flow rate through the machine.

Such additional air intakes may be used either alone or in combination with a further additional air intake formed in the wall of the adjusting means on the downstream side of the suction opening.

This latter air intake may extend throughout the breadth of the adjusting means and may preferably take the form of an auxiliary syphon provided with a flap which allows adjusting the input of air while the material which may drop out fortuitously during the suction stage into the air intake, collects at the bottom of the said auxiliary syphon.

I have illustrated diagrammatically by way of example

in accompanying drawings various embodiments of my improved arrangement. In said drawings:

Figs. 1 and 2 are respectively front and side elevational partly sectional views of a crusher provided with a lateral input and with the above referred to adjusting means;

Fig. 3 is a longitudinal sectional view of a pneumatic conveyor provided with similar adjusting means;

Fig. 4 is a perspective view of the simplest embodiment after removal of one of the side walls of the spyhon;

Fig. 5 shows on an enlarged scale the same embodiment in longitudinal cross-sectional view;

Fig. 6 is a general perspective view of the means for adjusting the flow rate;

Fig. 7 is a diagram showing the possible modifications of the curve defining the air passage;

Figs. 8 and 9 show two detectors for sensing the presence of the material in the syphon;

Figs. 10 and 11 show two maximum or minimum detectors utilizing a photocell;

Figs. 12, 13, 14 show three different forms of maximum and minimum detectors;

Figs. 15 and 16 are longitudinal sectional views of two alternative improved embodiments of the adjusting means.

Figs. 1 and 2 illustrate a crusher having a lateral input of a conventional type and with which the adjusting means according to my invention have been incorporated.

In said figures, **70** designates the body of the crusher, **71** the crushing chamber inside which the hammers **72** rotate, said hammers being carried by a shaft **73** adapted to revolve at a high speed.

74 designates the grate closing the crushing chamber at its lower end, and through which the crushed material drops onto a sloping surface **75** off which it is sucked through a suction opening **76** into a shell **77** under the action of the bladed rotor **78** of a suction device, while **79** designates an additional air intake through which it is possible to sweep the material off the grate of the crusher.

The feeding of said crusher is performed through a hopper **80** located above it and the lower end of which is provided with a distributor **81** including a gate **82** controlled by a lever **83** actuated through a nut **84** adapted to move vertically over a threaded member **85** driven into rotation by a motor and speed reducing group **86**. **87***a* and **87***b* designate two stops defining the stroke of the nut **84** and consequently that of the gate **82**.

The adjusting means forming the object of my invention are inserted between the distributor **81** and the upper section of the casing of the crusher **70**.

Said adjusting means are constituted as illustrated in Figs. 4 and 5 by a casing **2** formed by walls defining with one another three openings, to wit:

A first opening A of a rectangular shape located in a horizontal plane, which opening serves as an inlet for the feeding of the material into the arrangement;

A second opening B of a rectangular cross-section having the same size as the opening A and located in a horizontal plane coplanar with the first mentioned plane of the opening A or lying in proximity with the latter and separated from the said first opening A by the ridge C—D forming the lower edge of the downwardly concavely curved partition **2** defining the upper surface of the suction channel, the said opening B being the suction opening;

A third opening C of a rectangular cross-section located in a horizontal plane and separated from the second opening by the ridge G—H forming the upper edge of the upright partition **63**, the said third opening providing for the delivery of the pulverulent material downwardly into the crusher or the like machine (see Figs. 1 and 2);

These three openings A, B, and C lying in horizontal planes are defined in practice and as apparent from the drawing, by the gaps between the downwardly concave partition **2**, the rear wall of the casing and the front wall or partition **63** thereof.

The arrangement of the horizontal planes provided with the openings A, B and C associated with the bottom **5**, with the curved wall **2** and with the vertical partition **63** terminating with the ridge G—H, defines the syphon forming the adjusting means.

When the material to be crushed enters the regulator as illustrated by the arrow **1** shown in Fig. 1, it passes through the feed opening A and drops into the bottom **5** of the casing and it is then sucked through the opening B in the direction of the arrow **6** of Fig. 1. The path followed by the upper surface of the material inside the adjusting means crosses consequently the vertical plane extending perpendicularly to the openings A and B between the latter and through the ridge C—D. The line E—F shows the intersection between the said path and the said vertical plane, said line E—F being parallel with the ridge C—D.

If the flow rate of the material conveyed is low with reference to the capacity of the machine, the line E—F sinks away from the ridge C—D. If the flow rate increases, the line E—F rises towards the said ridge C—D. If the flow rate is too high, the said line E—F coincides with the ridge C—D. This leads to a clogging of the arrangement as a consequence of the complete closing of the gap through which the material is sucked in, as defined by the four-sided polygon C—D—F—E.

It should be remarked that, when the flow rate increases, i.e. when the line E—F rises towards the ridge C—D, there is a moment at which the arrangement is on the threshold of clogging. The line E—F registers then with a limit line which is designated in Fig. 1 by X—Y. The said line defines with the ridge C—D the normal suction gap ensuring maximum efficiency of the machine.

The adjusting means described are such that the lowermost point of the curve followed by the material is permanently tangent to the said line X—Y, said means including to this end a detector of levels located on the said line so as to allow adjusting accurately the flow rate through the machine by constraining the line E—F to coincide with the line X—Y. This provides for maximum efficiency without any risk of clogging.

The level detector may be a detector of the photocell type or an electronic presence detector. The said detector may act, as shown in Fig. 6, on an electric motor **8** adapted to revolve in both directions and which, when started, drive a worm **9** which produces a translational shifting of a nut operatively associated with a lever **12** pivoted at **13** so as to produce, according to its direction of movement, the opening or the closing of a gate **14** located at the end of the channel **15** opening above the feed-adjusting means. Switches **16** and **17** controlled at the ends of the strokes of the unit in either direction produce a stopping of the motor in correspondence with the closing and with the opening of the gate **14** respectively and they ensure simultaneously the desired safety by showing acoustically and/or optically that the feeding silo or the like is empty while the gate remains open, or reversely, that the adjusting means are still clogged while the gate remains closed.

It should be remarked that, in order to prevent any too sudden or frequent reversal of the motor controlling the feed of the adjusting means, which would lead to a constant beating of the adjusting gate **14**, it is possible to provide maximum and minimum detectors which allow stabilizing, as illustrated in Fig. 7, the flow rate to either side of the line X—Y between two lines corresponding to the allowed maximum and minimum rates.

The presence detectors **21** illustrated in Figs. 8 and 9 are adapted to act on the feeding of the machine according as to whether they are covered or not by the material

to be conveyed. The said detectors **21** are located at an adjustable height inside the syphon **22** so that the maximum or minimum defined by the said detector may be modified as desired.

In the case illustrated in Fig. 10, the maximum or minimum detector is constituted by the combination of the source of light **23** with the photo-cell **24**; the said source and photo-cell are arranged to either side of the body **25** of the syphon and the luminous beam produced by the projectors **23** impresses the cell **24** across the said syphon, the two walls of which are provided with openings **26** facing each other. According as to whether the beam of light **28** from the projector **23** is cut off or not by the material **29** inside the syphon, and consequently, according as to whether the cell **24** is illuminated or not, the said cell will act on the feeding of material into the syphon so as to reduce the throughput if the detector is a maximum detector or to increase the flow rate if the detector is a minimum detector.

When adjusting the maximum or the minimum, it is sufficient to shift the projector **23** in the direction of the arrow **31** of Fig. 10, the transparent plates **27** allowing a slight shifting of the luminous beam.

In the case of the modification illustrated in Fig. 11, the adjustment of the maximum or of the minimum is obtained through a modification of the angular position of the projector **23** and consequently through a modification of the angular setting of the beam of light.

A maximum and minimum detector may be constituted, as illustrated in Fig. 12, by two sets of projectors and photo-cells. The two projectors **32***a* and **32***b* are located above each other at different levels on the right hand side and on the left hand side of the syphon respectively, so as to produce luminous beams **33***a* and **33***b* adapted to impress the two cells **34***a* and **34***b* registering with the said projectors and also located at different levels. The cell **34***a* controls the reduction in the flow rate at the input end whenever the beam **33***a* is cut off by the material inside the syphon **35**. The cell **34***b* controls, in contradistinction, the increase of the flow rate at said input end whenever the beam **34***b* is no longer cut off by the said material. The level of the material **36** inside the syphon is thus constrained to move within narrow limits to either side of the dot-and-dash line *x*—*y*.

The adjustment of the average flow rate to either side of the said line *x*—*y* may be obtained by modifying the location of the projectors **32***a*, **32***b* the level of which may be adjusted with reference to that of the corresponding photo-cells **34***a*, **34***b*.

In the case where the products to be sucked out form a very irregular sheet or in the case of a machine having a very large cross-section, it is possible to resort to the maximum and minimum detector system illustrated in Fig. 13. The two projectors **37***a* and **37***b* are located in the central part of the syphon, above each other, while the beams produced by them as shown at **38***a* and **38***b* are adapted to impinge on the corresponding photo-cells **39***a* and **39***b* located to either side of the syphon **41**, the cell **39***a* defining the maximum flow rate, the cell **39***b* defining the minimum flow rate.

The adjustment is performed as precedingly through a shifting of the projectors **37***a* and **37***b* which are both housed inside a common casing **42**.

Obviously, only one of the projectors may be located at the center of the syphon, the other being located laterally as illustrated in dotted lines in Fig. 10, or else the two projectors may be located on the outside of the syphon and the two cells inside the central casing **42**.

As to the maximum and minimum detector illustrated in Fig. 14, it is constituted by a member **43** subjected to modifications in capacity and defining the maximum flow rate, the said member being associated with a projector **44** producing a beam of light **45** adapted to impinge on a photocell **46** so as to define the minimum flow rate. Obviously, the reverse solution is possible, in other words, the minimum may be detected by the member subjected to modifications in capacity while the maximum is detected by the luminous beam.

As illustrated in the drawings, the lateral openings **26** of the syphon are not closed, although they may be closed by transparent plates. These openings serve, as a matter of fact, not only for the passage of the luminous beams adapted to detect the maximum and the minimum, but also

They allow cleaning the lenses of the projector, which prevents any dust deposit from forming and thus giving erroneous results in the detection, since the suction produced in the syphon does not allow the material to escape through the openings **26** and the stream of air produced in the vicinity of the said openings ensures a permanent cleaning of the lenses;

The said openings form additional intakes which allow, in the case of a fortuitous clogging of the syphon, an automatic release of the said clogging; to this end, the centers of the two openings **26** which are coaxial, lie substantially at the level of the line *x*—*y* corresponding to the limit of clogging.

The two additional air intakes thus formed are advantageously completed by a further air intake formed by a slot **54** provided in the wall **50** of the syphon (Fig. 15).

However, in order to prevent on the one hand any introduction of foreign material inside the regulator through the channel **53** and on the other hand any passage of the material undergoing treatment through the said additional air intake or slot **54**, which passage may occur fortuitously either because the material subjected to suction follows the curved wall **50** or else, because in a hammer mill, the crushed material may be projected in the direction of the arrow **55**, I resort preferably to the arrangement illustrated in Fig. 16.

The wall **52** of the channel **53** lying ahead of the incurved wall **50** has in this case at its upper end an incurved section **56** forming a reversed syphon associated with a plate **57** the position of which may be adjusted through the levers **58** so as to modify the amount of air entering through said additional air intake.

Furthermore, at the level of the slot or additional air intake **54***a*, the wall **50** of the adjusting means carries downwardly curved plate **59** extending above a trough **61** inside which may collect any material projecting outside the main syphon underneath the wall **50**. This trough **61** may be adjusted as to position through a lever **62** so as to allow regulating the amount of additional air entering the adjusting means.

A further additional air intake may be constituted, as illustrated in Figs. 15 and 16, by a transverse partition **52** arranged vertically and the lower ridge of which extends downwardly into the opening A defining the input of material and is located at a level lower than that of the lower ridge of the wall **50**. The two walls **52** and **50** form together a vertical channel **53** extending transversely throughout the breadth of the arrangement so as to form this further additional air intake.

It is apparent that when the level of material inside the adjusting device reaches the lower ridge of the wall **52** and the machine is clogged, the air sucked in through the channel **53** allows a speedy release of the said clogging.

The adjustment of these different additional air intakes allows modifying simultaneously the average throughput of the arrangement. As a matter of fact, if, during normal operation, the average level of the material lies on the line defined by the cross shown in Fig. 16, and, if the additional air intake is throttled without any reduction in the amount of material fed into the arrangement, the level of the material inside the latter drops. For restoring the level, it is, consequently, necessary to increase the flow rate.

Reversely, if the additional air intake is opened to a wider extent without any modification of the feed, the level of the material inside the arrangement rises. It is, therefore, necessary to reduce the flow rate of material so as to restore the level to the desired value.

The closing and the opening of the additional air intake may be controlled from a distance by an auxiliary motor and by a worm or else, through any other suitable mechanical means.

The arrangement described may also show the following auxiliary features:

It includes at least in one of its side walls an inspection gate **18** (Figs. 4 and 7), wherethrough it is possible to inspect the level of the material and also to make sure that no foreign body shown at **19** and collecting at the bottom of the syphon formed by the ridge C—D reaches a level corresponding to the clogging area. The removable bottom **5** of the casing allows also emptying the latter from time to time so as to remove such foreign bodies at **19**;

The wall **63** the upper edge of which forms the ridge G—H separating the two openings B and C, may be adjustable and the same is the case for the upper incurved wall **2** guiding the material through the syphon. As a matter of fact, as illustrated in Figs. 4 and 5, the said wall **63** may be vertically slidable inside the regulator and the upper wall **2** may be pivotally secured along a horizontal line **64**. It is thus possible to shift the ridges C—D and G—H. These adjustments allow modifying the curve followed by the material entering the feed-adjusting means. By lowering the wall **63** with the ridge G—H or by raising the wall **2** with the ridge C—D, the entrance of heavy material inside the regulator is made easier. Obviously, however, the input curve for the material should not be such as might allow the latter to enter through mere gravity, since the syphon would no longer act as a clogging-limiting member and as a member preventing the entrance of foreign bodies;

To allow the material entering the adjusting means to be subjected to suction while it assumes the shape of a uniform layer, it is of advantage to provide in proximity with the bottom of the adjusting means and underneath the admission opening A a rotary member which ensures a suitable distribution of the material. Thus, the material reaches the adjusting means and consequently the crusher, as a layer of a uniform thickness and of a breadth corresponding to that of the input end of the crusher. Such a distribution is, furthermore, of considerable advantage for ensuring maximum efficiency for the crusher.

As stated hereinabove, the feed adjusting means according to my invention are adapted for use not only on hammer actuated crushers but with all suction means such as chiefly pneumatic conveyors.

Such feed adjusting means are, in fact, shown in the case of the application illustrated in Fig. 3, where **89** designates such a pneumatic conveyor pipe, in which the suction is exerted in the direction of the arrow **91**. **92** designates a gate closing normally the conveyor pipe **89** ahead of the lateral opening **93** to the periphery of which are secured the adjusting means. **94** designates a cover which normally leaves the opening **93** uncovered but allows if required closing the latter if the pipe **89** is to convey a product fed from a supply ahead of the gate **92**.

What I claim is:

1. An adjustable syphon controlling the flow of granular material, comprising a channel having an upper arcuate downwardly facing concave wall, means for feeding the granular material into one end of the channel longitudinally of the latter along lines extending in vertical planes round the lower edge of the corresponding end of said upper wall to urge said material through the channel, suction means adapted to draw the granular material out of the other end of said channel, the suction line defined by the upper surface of the material flowing through the channel following an incurved path the concavity of which is directed downwardly and the lowermost point of which at the first-mentioned end of the channel registers vertically with the lower edge of the upper wall of the channel at said first-mentioned end of the channel, at least one detector sensitive to the level of said lowermost point of the suction line with reference to a transverse horizontal line passing along said lower edge of the upper wall of the channel and means wherethrough said detector controls the flow of material through the material-feeding means to return the level of said lowermost point of the suction line into substantial coincidence with a predetermined position with reference to said transverse line.

2. An adjustable syphon controlling the flow of granular material, comprising a channel having an upper arcuate downwardly facing concave wall, means for feeding the granular material into one end of the channel longitudinally of the latter along lines extending in vertical planes round the lower edge of the corresponding end of said upper wall to urge said material through the channel, suction means adapted to draw the granular material out of the other end of said channel, the suction line defined by the upper surface of the material flowing through the channel following an incurved path the concavity of which is directed downwardly and the lowermost point of which at the first-mentioned end of the channel registers vertically with the lower edge of the upper wall of the channel at said first-mentioned end of the channel, at least one detector sensitive to the level of said lowermost point of the suction line with reference to a transverse horizontal line passing along said lower edge of the upper wall of the channel, an electric motor controlled by said detector and a gate controlled by said motor and controlling the flow of material into the material feeding means in accordance with the shifting of said level of the lowermost point of the suction line with reference to said transverse line.

3. An adjustable syphon controlling the flow of granular material, comprising a channel having an upper arcuate downwardly facing concave wall, means for feeding the granular material into one end of the channel longitudinally of the latter along lines extending in vertical planes round the lower edge of the corresponding end of said upper wall to urge said material through the channel, suction means adapted to draw the granular material out of the other end of said channel, the suction line defined by the upper surface of the material flowing through the channel following an incurved path the concavity of which is directed downwardly and the lowermost point of which at the first-mentioned end of the channel registers vertically with the lower edge of the upper wall of the channel at said first-mentioned end of the channel, two sources of light arranged to either side of the path followed by the material near the said lowermost point of the suction line, photo-cells located to either side of said path and subjected to the impact of the luminous beams produced by the sources of light, means for adjusting the relative position of the associated photo-cell and source systems, means whereby the photo-cells detect the rising and lowering respectively of the lowermost point of the suction line with reference to a predetermined line parallel with a horizontal transverse line passing along said lower edge of the upper wall of the channel, and means controlled by the photo-cells to control the flow of material through the material-feeding means and to return thereby the said lowermost point of the suction line towards the said predetermined line.

4. An adjustable syphon controlling the flow of granular material, comprising a channel having an upper arcuate downwardly facing concave wall, means for feeding the granular material into one end of the channel longitudinally of the latter along lines extending in vertical planes round the lower edge of the corresponding end of said upper wall to urge said material through the channel, suction means adapted to draw the granular material out of the other end of said channel, the suc-

tion line defined by the upper surface of the material flowing through the channel following an incurved path the concavity of which is directed downwardly and the lowermost point of which at the first-mentioned end of the channel registers vertically with the lower edge of the upper wall of the channel at said first-mentioned end of the channel, a detector of the presence of material, a photocell, a source of light producing a beam impinging on the photo-cell, said detector and photo-cell being adapted to detect respectively one of the extreme allowed shiftings of the lowermost point of the suction line to either side of a predetermined line parallel with a horizontal transverse line passing through said lower edge of the upper wall of the channel, and means whereby said detector and photo-cell adjust the flow of material through the material feeding means to urge said lowermost point into register with the said predetermined line.

5. An adjustable syphon controlling the flow of granular material, comprising a channel having an upper arcuate downwardly facing concave wall, means for feeding the granular material into one end of the channel longitudinally of the latter along lines extending in vertical planes round the lower edge of the corresponding end of said upper wall to urge said material through the channel, suction means adapted to draw the granular material out of the other end of said channel, the suction line defined by the upper surface of the material flowing through the channel following an incurved path the concavity of which is directed downwardly and the lowermost point of which at the first-mentioned end of the channel registered vertically with the lower edge of the upper wall of the channel at said first-mentioned end of the channel, at least one detector sensitive to the level of the lowermost point of the suction line with reference to a predetermined line parallel with a horizontal transverse line passing through said lower edge of the upper wall of the channel and at a short distance underneath last-mentioned edge, an auxiliary air intake opening into said channel, the center of which intake registers substantially with said predetermined line to provide for further suction on the material, and means wherethrough said detector controls the flow of material through the material feeding means to return the lever of said lowermost point of the suction line into substantial coincidence with said predetermined line.

6. An adjustable syphon controlling the flow of granular material, comprising a channel having an upper arcuate downwardly facing concave wall, means for feeding the granular material into one end of the channel longitudinally of the latter along lines extending in vertical planes round the lower edge of the corresponding end of said upper wall to urge said material through the channel, suction means adapted to draw the granular material out of the other end of said channel, the suction line defined by the upper surface of the material flowing through the channel following an incurved path the concavity of which is directed downwardly and the lowermost point of which at the first-mentioned end of the channel registers vertically with the lower edge of the upper wall of the channel at said first-mentioned end of the channel, an elongated slot being provided across the upper wall of the channel just ahead of its lower edge at said other end and adapted to provide a further suction on the material flowing through the channel, an adjustable flap controlling the amount of air passing through said elongated slot, means for collecting the material passing fortuitously out through said slot, at least one detector sensitive to the level of said lowermost point of the suction line with reference to a transverse horizontal line passing along said lower edge of the upper wall of the channel, and means wherethrough said detector controls the flow of material through the material-feeding means to return the level of said lowermost point of the suction line into substantial coincidence with a predetermined position with reference to said transverse line.

7. An adjustable syphon controlling the flow of granular material, comprising a channel having an upper arcuate downwardly facing concave wall, means for feeding the granular material into one end of the channel longitudinally of the latter along lines extending in vertical planes round the lower edge of the corresponding end of said upper wall to urge said material through the channel, suction means adapted to draw the granular material out of the other end of said channel, the suction line defined by the upper surface of the material flowing through the channel following an incurved path the concavity of which is directed downwardly and the lowermost point of which at the first-mentioned end of the channel registers vertically with the lower edge of the upper wall of the channel at said first-mentioned end of the channel, an inspection gate opening into the channel, a removable bottom through which foreign material may be removed out of the channel, at least one detector sensitive to the level of said lowermost point of the suction line with reference to a transverse horizontal line passing along said lower edge of the upper wall of the channel, and means wherethrough said detector controls the flow of material through the material-feeding means to return the level of said lowermost point of the suction line into substantial coincidence with a predetermined position with reference to said transverse line.

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