Sept. 8, 1959 D. W. DRYG 2,903,135

SIFTING APPARATUS

Filed June 26, 1956 2 Sheets-Sheet 1

PRIOR ART

Fig 1

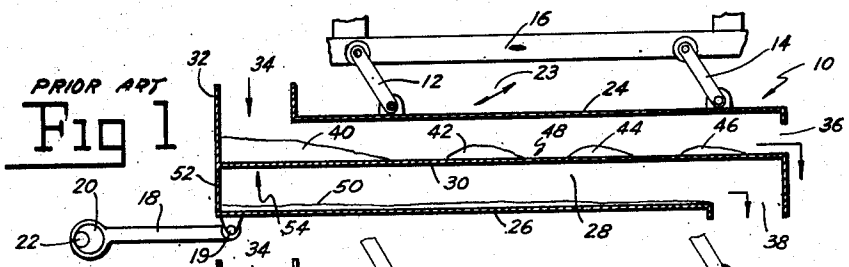
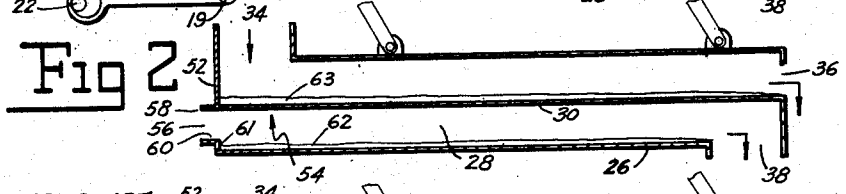


Fig 2



PRIOR ART

Fig 3

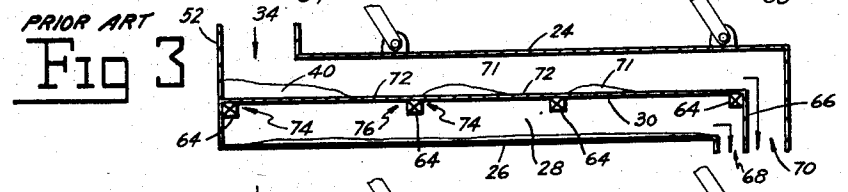
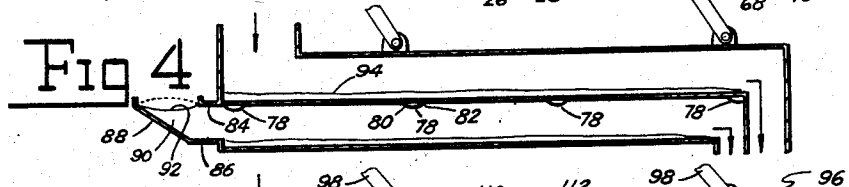


Fig 4



PRIOR ART

Fig 5

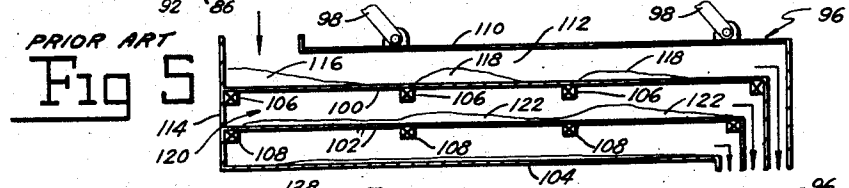


Fig 6

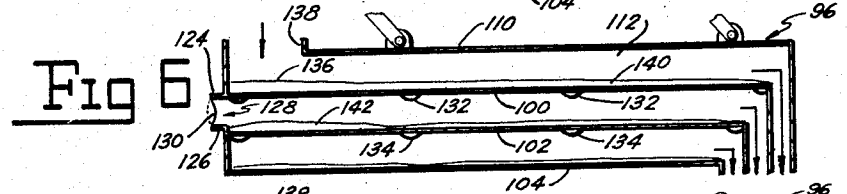
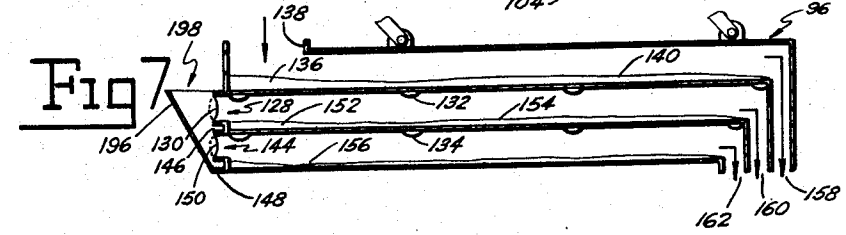


Fig 7



INVENTOR.
DONALD W. DRYG

BY William C. Babcock

ATTORNEY

Sept. 8, 1959 D. W. DRYG 2,903,135

SIFTING APPARATUS

Filed June 26, 1956 2 Sheets-Sheet 2

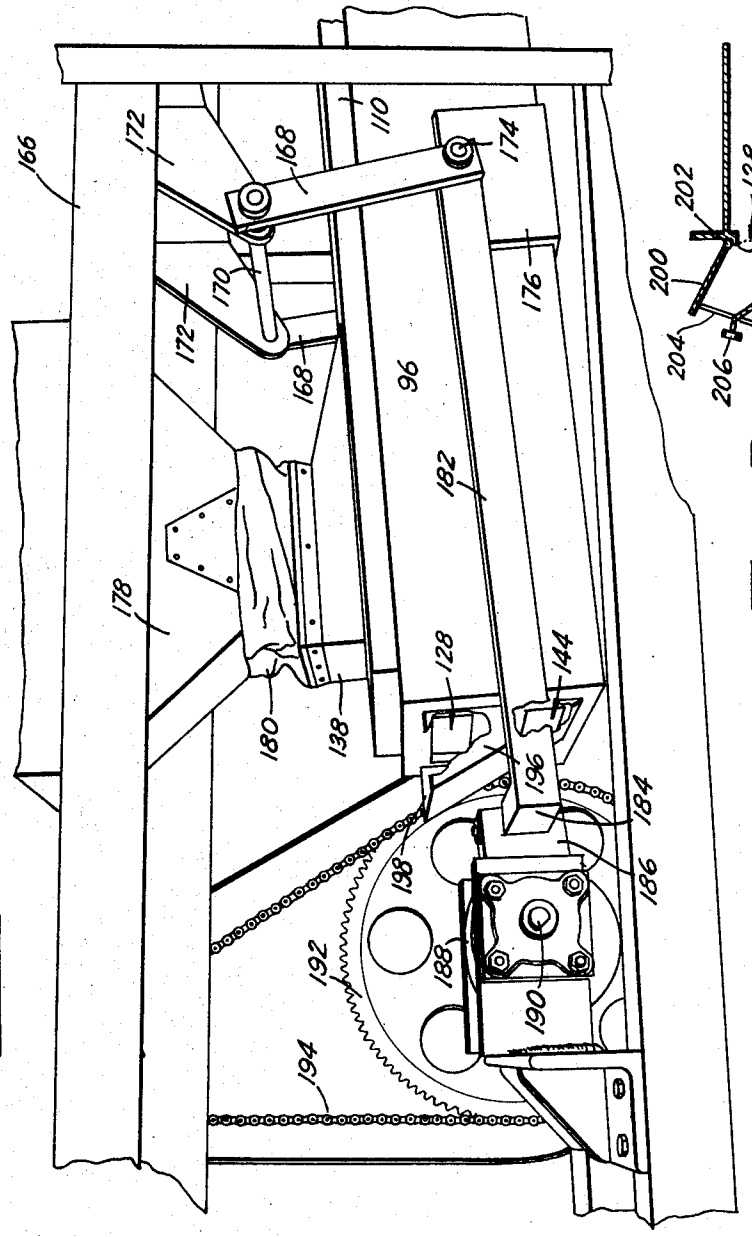


Fig 8

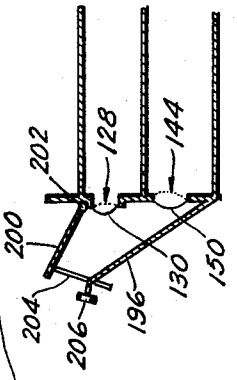


Fig 9

INVENTOR.
DONALD W. DRYG
BY
William C. Babcock
ATTORNEY

United States Patent Office 2,903,135 Patented Sept. 8, 1959

2,903,135

SIFTING APPARATUS

Donald W. Dryg, New Brighton, Minn., assignor to General Mills, Inc., a corporation of Delaware

Application June 26, 1956, Serial No. 593,967

19 Claims. (Cl. 209—236)

The present invention relates to sifting apparatus and more particularly to improvements in sifting devices particularly adapted for precision separation of finely powdered materials.

Sifting devices are known in which material is fed to one face of an appropriate sifting surface or screen. Suitable sifting movement is provided for the screen, with the result that some of the particles pass through the screen while others remain on the original face of it. It is also customary in such devices to provide a sifter box or body portion within which the screen is mounted, so that the body portion will prevent escape or loss of the particles of material being classified.

While known sifter constructions are satisfactory for a number of purposes and operations, I have found that the existing devices present certain unexpected difficulties in the processing of finely ground materials. These difficulties involve problems in the feeding of the material across the classifying surface, as well as problems in maintaining even distribution and proper action of the material on such surface.

After careful investigation of many of the factors involved, including such items as depth of stock, tension of the screening surface, types of surface, and directions and conditions of movement of the sifting surface, I have discovered that normal sifter constructions of the above type tend to cause a fluctuating absolute pressure differential between the space above and below the sifting surface. I have further found that such differences in pressure may cause the stock to be held fast to the sieve at the instant when it should have been free to slide along the sieve, while in other cases the stock may be blown up away from the sieve at the instant when it should be in close contact to obtain the desired accelerations.

In known devices, I find that it is sometimes possible to avoid the above problems by more violent sifting movement of the screening surface, and particularly by introducing higher frequencies and larger components of movement perpendicular to the screening surface. For many purposes, however, it is desirable to maintain the sifting movement as closely as possible in the very plane of the screen, particularly where one desires to create and maintain a particular stratification of the material.

The nature and reasons for such problems are discussed in further detail below. In addition to recognition of the problem I have provided a novel sifter construction which makes it possible to avoid the above difficulties and obtain accurate and precise sifting with finely ground materials.

It is accordingly one object of the present invention to provide an improved sifter construction in which fluctuations in absolute pressure differential between opposite surfaces of the screening surface are controlled or eliminated.

A further object is a sifting device in which the screening operation can take place within a closed sifting box to prevent loss of material, without the creation of undesired pressure differences on the opposing faces of the screen.

A further object is a sifter construction having means equalizing the freedom of movement of the fluid medium at opposite faces of the sifting surface.

Still another object is a sifting apparatus having means automatically equalizing the pressure changes caused at opposite faces of the sifting surface by sifting movement of such surface.

Other objects and advantages of the present invention will be apparent from the following specification in which certain preferred embodiments are described. In the drawings which accompany this application, and in which like reference characters indicate like parts,

Figure 1 is a schematic side elevation of a sifter of normal construction, which is shown in order to explain one of the problems of the prior art;

Fig. 2 is a view of one form of sifter according to the present invention incorporating novel means for elimination of the problem illustrated in Fig. 1;

Fig. 3 is a view similar to Fig. 1 which illustrates another of the problems which I have recognized in the prior art;

Fig. 4 discloses an embodiment of the invention adapted to minimize the problems of Figs. 1 and 3;

Fig. 5 is a view similar to Fig. 3 of a multiple surface sifting unit of orthodox construction with an illustration of the problems encountered therein;

Fig. 6 is a view similar to Fig. 5 showing one modification according to the present invention adapted to minimize certain of the problems of the device of Fig. 5;

Fig. 7 is a similar view of a further modification adapted to provide pressure equalized conditions at all of the multiple screens of the unit;

Fig. 8 is a partial perspective view of a screen of the type shown in Fig. 7, with certain of the flexible wall portions of Fig. 7 omitted; and

Fig. 9 is an enlarged schematic side elevation of the device of Fig. 8.

As shown in Fig. 1, the sifting apparatus to which the present invention is to be applied is designated generally at **10**. While certain of the principles of the present invention are applicable to other types of sifting units, for convenience in illustration the invention will be particularly described in connection with a reciprocating sifter as shown. Here the sifter box is mounted on hangers **12** and **14** which are pivotally mounted on a suitable supporting frame **16**. Pivotal connections at the upper and lower ends of each of the hangers **12** and **14** provide for swinging movement of the sifter unit to provide the desired sifting action and to move the material across the sifting surface.

The desired sifting movement is provided in known manner by a connecting rod **18** pivoted at one end at **19** to the sifter body. The other end of connecting rod **18** is secured to an eccentric **20** carried by a rotating drive shaft **22** which may be operated from a suitable source of power at a desired frequency in known manner. The amplitude of movement of eccentric **20**, the rate of rotation of shaft **22**, and the relative angle of the hangers **12** and **14** are adapted to cause the desired movement of the sifter along a path which extends generally longitudinally of the sifter in this case and in a direction perpendicular to the hangers **12** and **14**. This path of movement is shown for convenience by the two-headed arrow **23**.

The sifter unit itself includes a body portion consisting of suitable wall means adapted to enclose the material to be classified and prevent its loss. Thus the sifter body includes a top wall **24**, a bottom wall **26**, side walls **28**, and suitable end walls such as **52**. Within the body portion formed by said walls the sifting surface **30** is supported. This sifting surface **30** extends longitudinally

of the structure, and the general direction of vibrations indicated by arrow **23** is chosen to move the material along such surface from the head to the tail end of the screen.

The sifter includes means **32** providing an inlet opening **34** through which material can be fed onto the head end of the screen. At the opposite end of the unit independent outlets **36** and **38** are provided for separate discharge of the overs and throughs of the screening surface.

As indicated above, there are some types of sifting operations in which it is desirable to maintain the hangers **12** and **14** as nearly vertical as possible to obtain the desired sifting results. In such cases, the sifting movement of the surface **30**, indicated by arrows **23**, would be along a path making a relatively small acute angle with the sifting surface itself and lying in a generally vertical plane extending from the head to the tail end of the unit. Some angle is necessary at this point to provide the desired feeding action of the material from the head to the tail of the sifter, and also to assist in obtaining the appropriate sifting results.

I have found, however, that if one desires to use lower frequencies for the sifting movement, i.e., frequencies of 500 cycles per minute or less, with amplitudes of the order of 5/8 of an inch, there is a tendency for the material to back up or remain bunched at **40** at the head end of the screen. As the sifting movement is continued, certain lumps or masses of the material may break away from the edge of the mass **40** and shift down the screen as shown at **42**, **44**, and **46**. Between these masses there may be relatively bare spots **48** where no classifying action is taking place.

Apparently these problems have not been recognized before, and I have found that they may not even occur when such devices are operated at higher frequencies, i.e., of the order of 1,000 cycles per minute. Thus if the conveying force is sufficiently violent, either by increase in frequency, or possibly also by increase in the angle of hangers **12** and **14** to the vertical, a conveying force can be achieved which smooths out the flow of material on the upper surface of the screen. At the lower frequencies and lower hanger angles, however, I have discovered the problems illustrated in Fig. 1 and have discovered that they can be traced to a cause which, as far as I am aware, has not previously been recognized.

The orthodox sifter construction illustrated in Fig. 1 in effect is found to provide differences in the fluctuating air pressures at opposite faces of the screen **30**. Some of these pressure differentials apparently work in opposition to the desired sifting and conveying action. In seeking the causes of such fluctuations I have come to the conclusion that the sifter construction provides zones such as that shown at **54** in which the air or other fluid medium beneath the sifting surface does not have the same freedom of movement as the air above the surface. For example, it will be noted that the region **54** below the screen is one in which the body wall means provide an essentially closed chamber at the head end of the screen. On the other hand, the inlet **34** provides a sizable opening for the corresponding chamber portion above the screen. It is my belief that under certain conditions of operation, as noted above, the difference in relative freedom of movement of the fluid in these two chambers may cause pressure differentials giving rise to the undesirable results noted.

I have recognized, for example, that the air or fluid columns in the chambers above and below the screen have a slight but nonetheless definite inertia which tends to hold the fluid column stationary as the sifter vibrates. At **54**, however, if the sifter is moving to the right in Fig. 1, the tendency of the fluid to remain in its original position will produce a region of higher density or higher pressure at **54** during such movement. Conversely, when the sifter moves to the left in Fig. 1, the end wall **52** tends to move away from the enclosed column of air and thus produces an area of lesser density or lower pressure.

Above the screen **30**, however, the normal inlet opening at **34** will permit the escape of part of the air column above the screen during movement of the sifting unit to the right. The same inlet opening will also admit further air as the sifter moves to the left. Thus the inertia of the body of air above the screen will not cause pressure changes of the same magnitude as those below the screen. Hence there is a tendency as the unit moves to the right in Fig. 1 to have a higher pressure at **54** than in the zone above the screen. This higher pressure tends to lift the material at **40** away from the screen just at the point where it should be in contact with the sifting surface in order to obtain the desired conveying movement toward the right. Conversely, on the return stroke toward the left in Fig. 1, the lower pressure at **54** tends to draw the material at **40** down against the screen and move it to the left, just when it should in fact remain free of the screen in order to move in the desired direction toward the tail of the sifter.

I have also found that the vertical components of movement of the screen, i.e., the movements perpendicular to the screen, can cause pressure changes adjacent the screen surface. When the screen moves up, there tends to be a higher pressure immediately above it than below it. Conversely, downward movement of the screen causes higher pressures beneath it than above it. In the case illustrated in Fig. 1, these effects may work in opposition to the other pressure variations discussed. If hanger angles are increased these vertical movement effects can dominate the others. At lower frequencies and hanger angles, however, the pressure changes due to movements parallel to the sifter screen may become dominant. Thus proper control of the respective types of pressure change offers a means of obtaining desired improvement in sifting action.

In any event, and regardless of the correctness of the above stated theory, I have found that the construction in Fig. 2 avoids the problems shown at **40**, **42**, **44**, and **46** of Fig. 1. In this case the sifter is provided with means automatically equalizing the freedom of movement of the fluid above and below the screen surface. In this case, a suitable venting opening or passage is provided at **56**, the opening being defined by upper and lower walls **58** and **60**, respectively. Opening **56** is preferably equal in area to at least half the cross section of the end of the chamber **54** beneath the screen and is so located as to provide freedom of movement for the air column immediately beneath the screen. For this purpose the upper wall margin **58** is located substantially in the plane of the screen. The lower wall **60** may be spaced above the bottom wall **26** of the sifter box to provide a section at **61** adapted to prevent outward flow of the material **62** passing through the screen. In this case, as the sifter moves to the right, opening **56** provides substantially the same freedom of movement for the lower air column as inlet opening **34** does for the upper column. The instantaneous absolute pressures above and below the screen thus remain essentially balanced, and the material at **63** on the upper surface of the screen can be conveyed in a smooth layer without the problems of Fig. 1.

Fig. 3 illustrates what can happen in known sifter constructions when other portions of these sifter body means provide zones in which the fluid medium has less freedom of movement at one surface of the screen than at the other. In this case the screen surface **30** is supported on transversely extending cross beams **64** which have a relatively deep vertical cross section. Here the material passes from the inlet **34** toward the respective outlets **68** and **70**, which are separated by partition **66** to segregate the overs and throughs.

I have observed a bunching of the material at **40** (for reasons discussed in Fig. 1) and further bunchings of material at points **71**, with intervening thin or bare spots at

72. It is my belief that the large vertical area or cross section of the cross member 64 provides zones 74 and 76 located respectively ahead of and behind each of the cross members in which the fluid medium is less free to move than in the corresponding zones at the opposite surface of the screen.

Thus as the sifter moves to the right in Fig. 3, beam 64 tends to compress the air at 74. The higher pressure below the screen may lift the material at 71 away from the screen so that it does not receive the desired conveying movement to the right. Similarly, on the return stroke, the tendency to lower the pressure at 74 as the column of air tends to remain stationary, may hold the material at 71 against the screen when it should be free to slide above it.

Conversely, at regions 76 behind the cross beams, the net effect may be to enhance the conveying action by holding the material at 72 more firmly to the screen during the conveying movement to the right and blowing it even more free of the screen during the return movement. Hence the inequalities in depth may be established as shown at 71 and 72. Thus the relatively deep faces of supporting beams 64 have the same net effect as the closed end wall 52 at the head end of the sifter beneath the screen as described in Fig. 1. End wall 52 obviously has the same effective problem in Fig. 3 as in Fig. 1.

Fig. 4 shows a modification of the device of Fig. 3 adapted to control both of the problems above discussed. First of all, the respective cross members 78 are so designed as to provide a relatively thin elongated cross section in the direction of the path of sifting movement of the screen. The tapering of the trailing and leading edges 80 and 82 of these cross members in effect provides a streamlined shape which offers a convenient passage for free movement of air or fluid longitudinally of the screen adjacent said cross members.

Here again, a suitable opening is also provided in the end walls 52 of the screen by means of wall portions 84 and 86. The lower wall 86 may be inclined upwardly at 88 to provide a passageway 90 of gradually increasing cross section. The effect of the increasing cross section will be to gradually decrease the linear velocity of air or fluid passing through the opening at 84 during sifting movement of the device. Adequate reduction of this linear velocity is designed to help prevent particles of the sifted material from being projected out of the sifter.

According to another feature of the invention, the venting opening may be provided with a suitable cover or closure of flexible sheet material as shown at 92. The area of this closure is substantially greater than the area of the opening cross which it is placed, as shown in Fig. 4. There will be enough material at 92 to flex between the heavy line and dotted line positions of this figure in response to fluctuations in pressure beneath the screen.

Thus movement of the sifter to the right, as the air column remains stationary, would tend to permit free movement of some of the air outwardly between walls 84 and 86 to flex the closure or diaphragm 92 up to the dotted line position of Fig. 4. Conversely, return movement of the sifter to the left should flex the diaphragm downwardly to the heavy line position.

Fig. 5 illustrates the problems which I have recognized in connection with a standard double deck sifter of the same general construction as the previous devices. Here the sifter 96 is suspended by hangers 98 and includes upper and lower sifting surfaces or screens 100 and 102, respectively. A bottom wall 104 provides a conveying support for the throughs of both screens. Cross members 106 support the upper screen, and cross members 108 support the lower screen. These cross members are shown as made with normal deep vertical cross section. The sifter body is completed by a top wall 110 and side walls 112, with suitable end walls 114.

In the absence of means equalizing the freedom of movement of the fluid within the sifter box, according to the present invention, the material on the upper screen will bunch at 116 and 118, for reasons discussed above, under certain operating conditions. In this case there may be no particular problem at 120 since the closed box does provide substantially equivalent closed chambers above and below the lower screen. At points 122, however, the presence of the cross members changes the relative freedom of movement in the respective zones and produces the problems indicated.

According to the present invention the problems in connection with the upper screen surface 100 can be reduced or eliminated by essentially the same steps previously used. Here the box is modified to provide walls 124 and 126 defining a vent opening 128 in the end wall 114 immediately below the upper screen surface. To prevent escape of the material being sifted, a flexible closure member 130 similar to the member 92 discussed above is secured across the opening 128. In Fig. 4, however, the flexible closure was secured in substantially the same plane as the path of sifting movement of the unit. Thus the sifting movement itself did not tend to change the position of the member 92 to any substantial extent. In that case the desired change in position of the barrier layer had to be obtained solely by virtue of the effect of the air column beneath the screen.

In Fig. 6, on the other hand, the flexible closure 130 is oriented in a plane substantially transversely of the path of sifting movement of the unit. Thus the inertia of the member 130 also contributes, in combination with the sifting movement, to produce the desired change in position of the barrier 130 and thus maintain the desired freedom of movement of the fluid medium beneath the upper screen. In Fig. 6, if the opening is provided only beneath the upper screen, an even flow can be obtained at 136, but there will then be an undesired accumulation at 142 on the lower screen. The provision of thin or streamlined cross members 132 and 134 for the upper and lower screens in this device provides greater freedom of movement of fluid in the zones immediately adjacent these cross members and thus eliminates the problems noted at 118 and 122 in Fig. 5.

If the device of Fig. 6 is now further modified by the introduction of another vent means for the relatively closed chamber beneath the head end of the lower screen, maximum efficiency of sifting can be obtained with the complete unit. Here the opening 144 is provided by wall portions 146 and 148. A vertical flexible closure or diaphragm 150 prevents escape of material at this point just as in the case of member 130 above. In this embodiment of the invention, the material is fed into the inlet 138 on to the head end of the upper screen and can move smoothly toward the tail end of the unit at 136 on the upper screen, at 152 and 154 on the second screen, and at 156 on the bottom wall of the sifter. The various overs and throughs of the screens are then separately collected at discharge outlets 158, 160, and 162.

In the device of Fig. 7, the venting openings 128 and 144 have also been provided with an enclosing passageway defined by walls 196. The passageway is of gradually increasing cross section to its top opening 198. While such a passageway may be omitted if separate closure members 130 and 150 are provided, as indicated, the passageway may in some cases be used in the absence of such closure members to prevent outward sifting of the stock It may also be used for control purposes as described below.

The device of Fig. 7 and its actual construction and mounting details are more fully shown in Fig. 8. Here the sifter unit 96 and its supporting hangers 168 are suspended from a main supporting frame 166 by a cross shaft 170 carried in brackets 172. The lower ends of the hangers 168 are pivoted at 174 to a supporting yoke 176 in which one end of the sifter 96 is carried. The other end of the sifter is similarly supported in swinging hanger members (not shown). Here the desired sifting move-

ment is transmitted to the sifter at the lower hanger pivots 174 by means of spaced bars 182 connected to a cross member 184. Member 184 is in turn formed as part of a driving yoke having a head portion 186 connected to an eccentric 188 carried by rotatable shaft 190. A gear 192 on shaft 190 is driven by chain 194 from a suitable power source to provide the desired frequency of sifting movement.

Material is fed into the inlet 138 of the sifter from a supply hopper or other source 178 through a flexible sleeve connection 180 in known manner. Openings 128 and 144 provide the desired venting action for the otherwise relatively closed chambers beneath the respective sifting surfaces at the head end of the unit. In this case the separate flexible closures are omitted, and the walls 196 provide a passageway of outwardly and upwardly extending orientation, with gradually increasing cross section toward the top opening 198. Should the increasing cross section and upward orientation of the passage be insufficient in themselves to prevent outward dusting of the throughs of the respective screens, then the individual flexible closures described in connection with the previous figures may be added as at 130 and 150.

In cases where such flexible closures are used, it is important that they be made of sufficiently light material, with adequate cross sectional area to achieve the desired freedom of movement of the confined air column. For example, in the operation of a device substantially similar to that shown in Fig. 4, a flexible closure of plastic material, such as polyethylene, with a thickness of one to two mils. was satisfactorily used. However, the addition of a 25¢ coin to the upper surface of the diaphragm was found to offer sufficient resistance to the free movement of this flexible closure under certain conditions of sifting movement to produce uneven feeding and distribution on the screen just as in the case of Fig. 1. Therefore it is important that the flexible closures be free to move without restraint to an extent sufficient to accommodate the necessary volume of air under the particular conditions of sifting vibration. In effect, such a flexible closure constitutes a flexible wall portion which in turn constitutes means automatically varying the volume of the closed chamber or zone beneath the sifting cloth to equalize the freedom of movement and the instantaneous air pressures on opposite faces of the screen.

It is also possible in accordance with the present invention to provide adjusting means by which the relative freedom of movement of the fluid can be controlled to a greater or lesser degree to achieve desired sifting results in a particular case. Thus in Fig. 9 a modification of the device of Figs. 7 and 8 is sought for control purposes. Here the passageway at the outer side of the barrier layers is provided with an adjustable cover member 200 pivoted at 202. The cover has a control slide 204 which can be secured in various adjusted positions by clamp 206. Thus the cover may be completely closed or opened to an extent giving full effect to the relatively large opening at the top of the upwardly tapering passage. If the cover is closed completely, then the fluid trapped between the cover and the barrier layers will substantially resist flexing movement of the barrier and thus tend to resist freedom of movement of the air columns beneath the head ends of the respective screens. On the other hand, if the cover 200 is opened wide, the barrier layers will have maximum freedom of flexing movement. Adjustment of the cover thus provides a convenient means for controlling or adjusting the relative freedom of movement of the air columns in a horizontal direction. Thus the air pressure effects on sifting, as discussed in Fig. 1, can be modified or decreased as needed in a particular case. Obviously the control of these effects, in coordination with the effects due to vertical movement of the sifting surface, offers a means of obtaining various desired combinations of sifting and conveying action. In appropriate cases, instead of a movable cover which is adjustable among different fixed positions, similar results could be achieved by a movable cover or barrier layer with suitable means for adjustment of the resistance of such cover to movement in response to inertia of the parts and/or air pressure factors.

The combination and arrangement of sifter features described in the foregoing specification thus provide an improved sifter unit which essentially accomplishes the objectives set forth at the beginning of this application.

While the present improvements have been described in connection with sifters, and particularly reciprocating sifters, it will be recognized that certain of the features and principles of this invention may also have utility in other devices, such as flour middlings purifiers, in which the design provides a movable sifting surface with opposed zones in which equivalent freedom of fluid movement may be desired.

Since minor variations and changes in the exact details of the apparatus features will be apparent to persons skilled in this field, it is intended that this invention shall cover all such changes and modifications as fall within the spirit and scope of the attached claims.

Now, therefore, I claim:

1. In a sifting apparatus which comprises a sifting surface for classifying relatively fine particles of material, means for producing sifting movement of said surface in the presence of a fluid medium, and body wall means moving with said sifting surface and forming a zone at one face of the sifting surface in which zone the fluid medium has less freedom of movement in response to said sifting movement than at the other face of the sifting surface opposite said zone, the improvement comprising equalizing means providing a fluid passage communicating with said zone, said passage having a location and cross sectional area increasing the freedom of movement of fluid at said one face of the sifting surface at said zone.

2. Sifting apparatus according to claim 1 in which said sifting movement includes reciprocation along a given path, said body means includes a wall member extending transversely of said path and reciprocating with said body means and sifting surface along said path, and said equalizing passage comprises an opening in said last mentioned wall member, said passage having a cross sectional area equal to at least half the cross sectional area of the end of the zone at said one face of the sifting surface.

3. Sifting apparatus according to claim 2 having means preventing escape of particles from said zone through said passage.

4. In a reciprocatory sifting apparatus for classifying relatively fine particles of material which comprises a generally horizontal sifting surface, inlet means for feeding material onto one end of the surface, outlet means at the other end of the surface, means for producing sifting and conveying movement of said surface back and forth along a path extending at an acute angle to said surface and in a generally vertical plane parallel to the desired direction of particle movement from said one end to the other, and body wall means moving with said sifting surface and providing a restricted chamber beneath said one end of the sifting surface below said inlet means, the improvement comprising means for automatically varying the volume of said chamber in response to said sifting movement and thereby equalizing the pressures beneath and above said surface during said sifting movement.

5. Sifting apparatus according to claim 4 in which said volume varying means includes a movable wall portion which automatically increases the volume of said restricted chamber in response to slight increases in pressure within the chamber at each sifting movement.

6. Sifting apparatus according to claim 4 in which said wall means includes a wall extending transversely of the path of sifting movement and moving with said sifting surface along said path, and said volume varying means

includes means defining an opening in said transverse wall.

7. A reciprocating sifter having a generally horizontal screen surface for classifying relatively fine particles of material, a sifting box in which said screen is supported, said sifting box having walls defining first and second chambers above and below the screen and separated thereby, inlet means at a first end of the first chamber for depositing material at the corresponding end of the screen, separate outlet means at the opposite end of each chamber for separate handling of the various overs and throughs of said screen, means for producing reciprocating sifting and conveying movement of said sifting box and surface along a path in a generally vertical plane parallel to the desired direction of particle movement from said inlet to said outlets, and a venting opening in said sifting box at a point located in the first end of the second chamber, said venting opening having an area and location relative to said inlet means equalizing the freedom of movement of fluid in the two chambers and thereby minimizing fluctuations in the pressure differences between opposite surfaces of said screen during reciprocating operation of the sifter.

8. A reciprocating sifter according to claim 7 in which said venting opening has an area equal to at least half of the cross sectional area of the end of the lower chamber beneath the sifting surface.

9. A sifter according to claim 7 in which said venting opening is located in an end wall of the sifter box and having means cooperating with said opening to prevent escape of the material.

10. A sifter according to claim 9 in which said cooperating means includes a passage extending outwardly and upwardly from the opening, and said passage has a gradually increasing cross section adapted to gradually reduce the effective rate of linear movement of fluid passing through said venting opening and thereby provide gravity return for any particles carried by said fluid.

11. A sifter according to claim 10 having a flexible sheet of fluid tight barrier material closing the outer end of said passage and extending in a generally horizontal plane for flexing movement primarily as a result of fluid flow in the passage.

12. In a sifting apparatus which comprises a sifting surface for classifying relatively fine particles of material, means for producing sifting movement of said surface in the presence of a fluid medium, and body means forming opposed zones at opposite faces of the sifting surface in which zones the fluid medium may have different freedom of movement in response to said sifting movement, the improvement comprising adjustable means for varying the effective freedom of fluid movement in at least one of said zones.

13. In a sifting apparatus which comprises a sifting surface for classifying relatively fine particles of material, means for producing sifting movement of said surface in the presence of a fluid medium, said sifting movement including reciprocation along a given path, and body means forming a zone at one face of the sifting surface in which zone the fluid medium has less freedom of movement in response to said sifting movement than at the other face of the sifting surface opposite said zone, the improvement comprising equalizing means providing a fluid passage communicating with said zone, the said passage having a location and cross sectional area equalizing the freedom of movement of fluid at both faces of the sifting surface at said zone, said body means including a screen support extending across said path of reciprocation and movable with the screen, and said equalizing means including a relatively streamlined cross section on said support oriented to provide relatively free passage of air across said support in the direction of said path.

14. In a sifting apparatus which comprises a sifting surface for classifying relatively fine particles of material, means for producing sifting movement of said surface in the presence of a fluid medium, said sifting movement including reciprocation along a given path, and body means forming a zone at one face of the sifting surface in which zone the fluid medium has less freedom of movement in response to said sifting movement than at the other face of the sifting surface opposite said zone, the improvement comprising equalizing means providing a fluid passage communicating with said zone, the said passage having a location and cross sectional area equalizing the freedom of movement of fluid at both faces of the sifting surface at said zone, said body means including a wall member extending transversely of said path, and said equalizing passage comprising an opening in said last mentioned wall member, and means preventing escape of particles from said zone through said passage, said preventing means including a flexible imperforate sheet extending across said opening, the area of said sheet being substantially larger than the area of said opening and thereby providing a flexible wall portion which moves freely in response to changes in relative position of the sifting surface and the fluid in said zone during said sifting movement.

15. In a reciprocatory sifting apparatus for classifying relatively fine particles of material which comprises a generally horizontal sifting surface, inlet means for feeding material onto one end of the surface, outlet means at the other end of the surface, means for producing sifting and conveying movement of said surface back and forth along a path extending at an acute angle to said surface and in a generally vertical plane parallel to the desired direction of particle movement from said one end to the other, and body wall means providing a restricted chamber beneath said one end of the sifting surface below said inlet means, the improvement comprising means for automatically varying the volume of said chamber in response to said sifting movement and thereby equalizing the pressures beneath and above said surface during said sifting movement, said volume varying means comprising an opening in the wall means defining said chamber, and a readily movable barrier layer cooperating with said opening to provide a flexible closure which prevents loss of material from the chamber, the size of said opening and the extent of flexible movement of the barrier being adapted to provide sufficient freedom of fluid movement through the opening to minimize pressure differentials causing pumping of fluid through said sifting surface.

16. Sifting apparatus according to claim 15 in which said wall means includes a wall extending transversely of the path of sifting movement and said volume varying means includes means defining an opening in said transverse wall and in which said volume varying means also includes a readily flexible barrier layer cooperating with said opening to accommodate free fluid movement back and forth through the opening during said sifting movement, said barrier layer lying in the general plane of said wall for automatic flexing due to both its own inertia and the relative shifting of fluid in the chamber during said sifting movement.

17. A reciprocating sifter having a generally horizontal screen surface for classifying relatively fine particles of material, a sifting box in which said screen is supported, said sifting box having walls defining first and second chambers above and below the screen and separated thereby, inlet means at a first end of the first chamber for depositing material at the corresponding end of the screen, separate outlet means at the opposite end of each chamber for separate handling of the various overs and throughs of said screen, and a venting opening in said sifting box at a point located in the first end of the second chamber, said venting opening having an area and location relative to said inlet means equalizing the freedom of movement of fluid in the two chambers and thereby minimizing fluctuations in the pressure differences between opposite surfaces of said screen during reciprocat-

ing operation of the sifter, said venting opening being located in an end wall of the sifter box and having means cooperating with said opening to prevent escape of the material, said cooperating means including a flexible sheet of fluid tight barrier material closing the venting opening and extending generally in the plane of said end wall for flexing movement both by fluid flow through the opening and by inertial resistance to the reciprocating operation of the sifter.

18. A sifter according to claim 17 having adjustable means for varying the effective flexing movement of the barrier material and thereby adjusting the relative freedom of fluid movement in the second chamber.

19. A sifter according to claim 18 in which said adjustable means comprises a wall portion providing an auxiliary chamber at the outer side of said barrier material, said chamber having a vent opening, and adjustable means for varying the effective area of the vent opening.

References Cited in the file of this patent

UNITED STATES PATENTS

110,635	Cunningham	Jan. 3, 1871
398,692	Bittenger	Feb. 26, 1889
2,713,942	Von Rechenberg	July 26, 1955

FOREIGN PATENTS

347,555	France	Jan. 9, 1905
218,593	Switzerland	Apr. 16, 1942
743,902	Great Britain	Jan. 25, 1956