Jan. 15, 1957 R. P. MILLER ET AL 2,777,578

SCREENING MECHANISM

Original Filed Sept. 10, 1949 2 Sheets-Sheet 1

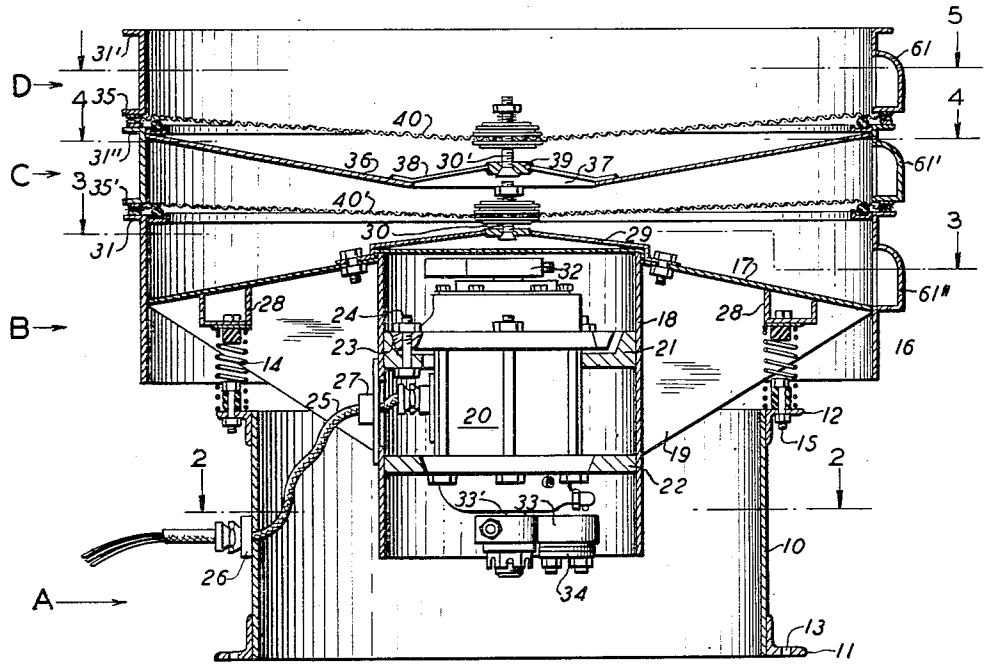


FIG. 1

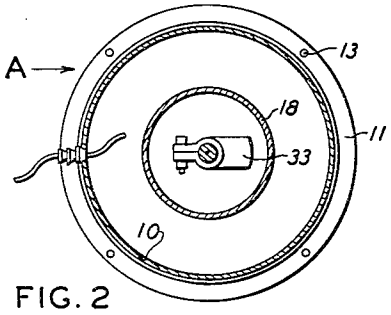


FIG. 2

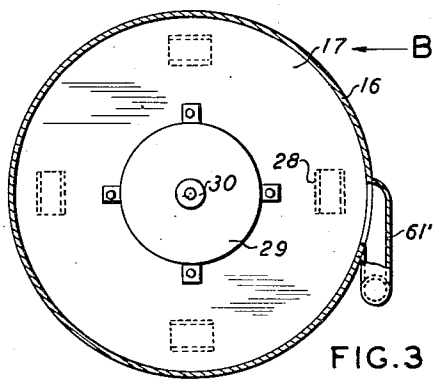


FIG. 3

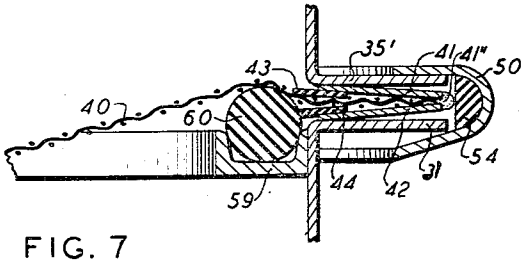


FIG. 7

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SCREENING MECHANISM

Original Filed Sept. 10, 1949 2 Sheets-Sheet 2

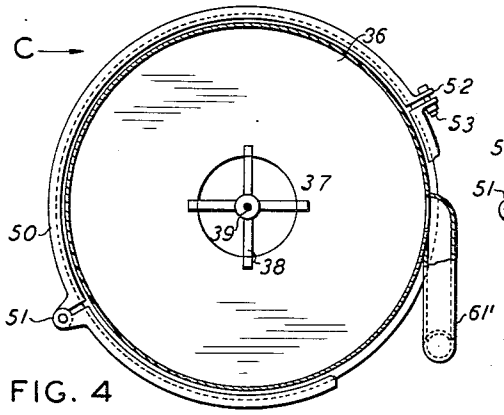


FIG. 4

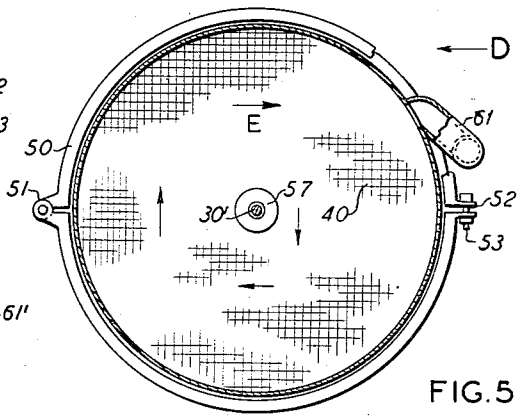


FIG. 5

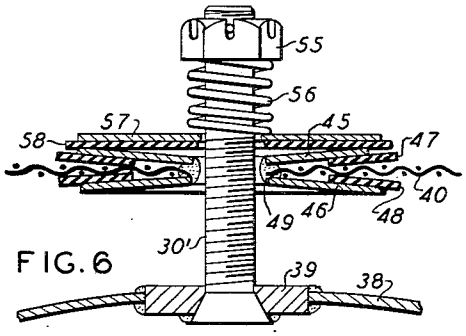


FIG. 6

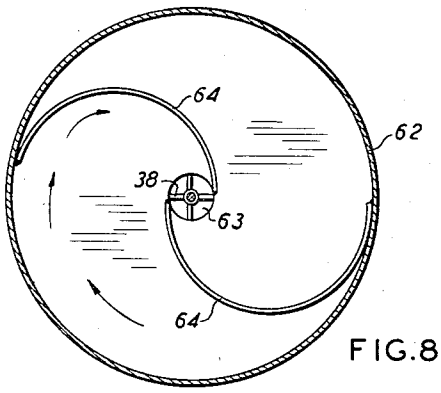


FIG. 8

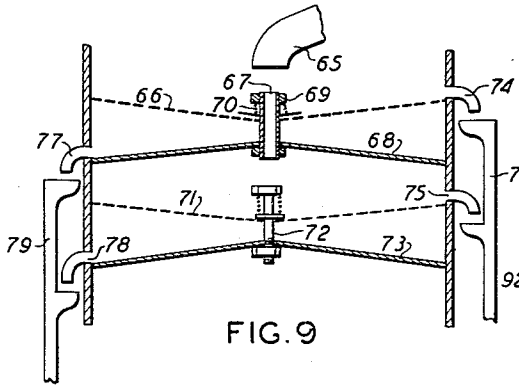


FIG. 9

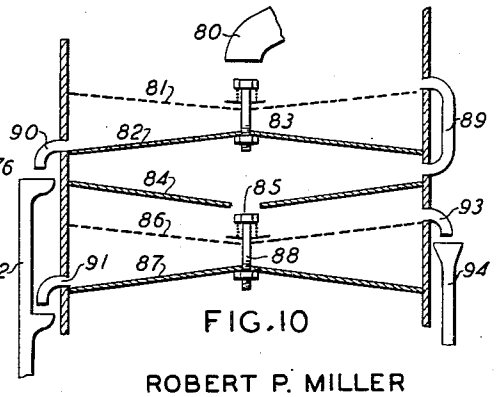


FIG. 10

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2,777,578

SCREENING MECHANISM

Robert P. Miller, San Gabriel, and Frank Mathewson and Gotthold Harry Meinzer, Glendale, Calif.; Nell Watson Meinzer, administratrix of said Meinzer, deceased, assignors, by direct and mesne assignments, of forty percent to The Farmers and Merchants National Bank of Los Angeles, executor of the estate of Paul W. Prutzman, deceased

Original application September 10, 1949, Serial No. 114,966, now Patent No. 2,714,961, dated August 9, 1955. Divided and this application January 25, 1952, Serial No. 268,314

2 Claims. (Cl. 209—243)

This application is a division of our copending application Serial No. 114,966, filed September 10, 1949, now Patent No. 2,714,961, and entitled "Screening Mechanism."

This invention relates to apparatus for separating granular and pulverulent solid materials into desired size ranges by passage over and through foraminous media such as wire mesh screens, plastic screen cloth and the like.

The invention is illustrated herein as embodied in a screening apparatus of the type described in United States Patent 2,284,671, entitled "Shaking Device," issued June 2, 1942, to G. H. Meinzer, in which the screening element is subjected to a gyratory motion in a substantially horizontal plane and simultaneously to progressive tilting around its own center, reference being made to the said patent for a full description of the basic elements of the structure and the manner in which the described gyratory and tilting movements are produced.

It will be understood, however, that certain features of the invention, to which attention will be directed, are applicable to other types of screening apparatus, and that such elements are not limited to use in an apparatus having the combination of movements described in the Meinzer patent.

In the original patent above mentioned the Meinzer apparatus is shown diagrammatically, and while the form there illustrated is fully functional and displays all the merits claimed for it, the structure is only indifferently adapted to large scale continuous use in heavy duty. The improvements over the original design, as described and claimed herein, include:

Means for so mounting the driving motor with its attached counterweights as to afford a rigid connection with the screen-carrying frame and to protect the motor from damage while leaving it freely accessible for repair and for adjustment or replacement of weights;

Means for mounting the screen cloth in a protecting ring and for placing the cloth under an initial tension before positioning it in the screen stack;

Means for completing the tensioning of the cloth after it is positioned in the stack, such means further protecting the cloth against destructive whip;

Means for protecting the periphery of the cloth from contact with any rigid support, thus avoiding risk of peripheral cracking or tearing;

Means for assembling superposed screen sections in dust-free contact without the use of bolts, said means further permitting the sections to be rotated to bring the discharge spouts into any desired radius;

Means for feeding two screens of the same mesh in parallel or in series, to avoid overloading of one screen or a stack;

Means for controlling the retention of the feed on the upper surface of the screen;

Means for maintaining substantially the original tension on the screen cloth during an extended period of use without manual readjustment, and

Means for returning the throughput from one screen to a central position on the screen next below.

These improvements, which will now be described in detail, are useful and valuable individually and in different types of screening apparatus, while in combination in a structure of the Meinzer type they produce a screening mechanism of unusual capacity, versatility and durability.

The advantages of the invention will become evident on inspection of the attached drawings and the following description thereof, in which

Fig. 1 is a vertical section on the center line of the assembled apparatus, showing the motor and counterweights in elevation and omitting the clamping ring shown in Fig. 7;

Fig. 2 is a cross section through the subframe A, as on the line 2—2 of Fig. 1;

Fig. 3 is a cross section through the screen-supporting section B, showing certain underlying members in plan, as on the line 3—3 of Fig. 1;

Fig. 4 is a cross section through an intermediate screen frame C, showing one of the feed return pans in plan, as on the line 4—4 of Fig. 1;

Fig. 5 is a cross section through the upper screen frame D, showing the uppermost screen cloth in plan, as on the line 5—5 of Fig. 1;

Fig. 6 is a vertical section through a central fragment of a screen cloth and the means by which the cloth is placed under its final tension and is protected from damage due to vibration;

Fig. 7 is a sectional detail through the outer edge of the screen cloth and the rings between which the cloth is retained, showing also the manner of assembling superposed screen frames;

Fig. 8 is a plan view of a flat-bottomed feed return pan provided with baffles for directing the feed to the central opening;

Fig. 9 is a diagram showing an arrangement of screens, pans and conduits by the use of which two screens of the same mesh may be operated in parallel, and

Fig. 10 is a similar diagram showing an arrangement permitting two screens of the same mesh to be operated in series.

Referring first to Figs. 1 to 5 inclusive, the lowermost element or subframe A of the machine consists of a cylinder 10 of steel plate provided with angle iron flanges 11 and 12 at its lower and upper ends. The lower flange should have several bolt holes 13 for attachment of the subframe to a floor or foundation. As almost no vibration is transmitted to the subframe when the machine is in operation and there is little or no tendency to walk, the foundation of whatever kind need only be sufficient to carry the dead weight of the machine and its operating load.

The upper flange carries a plurality of open coil springs 14, preferably four in number, interposed between the subframe and the screen-carrying frame B. These springs support the screens, motor and other moving parts of the apparatus and permit the screens to gyrate and tilt in the manner described in the Meinzer patent. Generally speaking, the stiffness of the springs should be such that they will be only slightly deflected, in a closing direction, by the dead weight of the supported parts of the mechanism when empty, and only partially closed by the dead weight of these parts when loaded. The lower ends of these springs are rigidly affixed to the upper flange as by bolts 15.

The supporting section B consists of a short steel plate cylinder 16 within which is welded a truncated, relatively flat, steel plate cone 17 which in turn carries a motor housing 18. Radial plates 19 stiffen this structure and prevent vibration of the housing with respect to the cone. A vertical electric motor 20 is supported within the housing on internally projecting rings 21 and 22, the motor being locked in position as, for example, by means of conical wedges 23 and drawbolts 24. Electrical connections may be made to the motor in any convenient manner, as for example through a freely flexible conduit 25 passing through bushings 26 and 27 in the walls of the subframe and housing. The upper ends of springs 14 are bolted to stirrups 28 projected from the lower face of cone 17. A shield plate 29, slightly dished upwardly, is removably bolted over the upper end of the motor housing, and a tension bolt 30 is projected upwardly from the center of the plate. The upper end of cylinder 15 is provided with a flange 31 to which the stack of screen frames is attached as will be described.

The motor 20 is provided, as in the Meinzer patent, with unbalanced weights 32 and 33, attached respectively to the upper and lower ends of the motor shaft 33' in such manner that their radial angle may be varied. Either or both of these weights may also be varied in magnitude, the upper most conveniently by substituting one weight for another, the lower by attachment or removal of bolted-on weights 34.

The stack resting on the upper flange 31 of the supporting section may consist of any required number of screens, reserving that it is undesirable to make the stack so high as to be topheavy. If but two fractions are to be made (one over and one through) only one screen frame will be required, this being the upper frame D. If a greater number of separations are to be made, one or more intermediate frames C must be provided.

The form indicated at D, which in any case will be the uppermost of the stack, is a short cylinder of steel plate having an upper flange 31' and a lower end flange 35. The form indicated at C, which will be used in any intermediate position, has an upper end flange 31'', a lower flange 35', together with a feed return pan 36 and means later described for protecting the periphery of the screen cloth against damage.

The feed return pan, the purpose of which is to collect the undersize passing through the screen next above and direct it to the center of the screen next below, is a shallow cone of light sheet metal having a central opening 37. Over this opening is placed a spider 38 having a central boss 39 from which a tension bolt 30' is directed upwardly.

The screen cloth 40 is mounted in a circular frame composed of two flat metallic rings 41 and 42 (see Fig. 7) and narrow rings 43 and 44 of rubber or other elastic material interposed between the screen cloth and the inner edges of the metallic rings. Before mounting, the cloth is stretched evenly in both directions, in any convenient manner, until it lies flat and smooth, after which the above described rings are applied on opposite sides, the outer edges of the metallic rings are brought into close contact with the cloth, and these edges are spot welded to the cloth and to each other as at 41'', after which projecting portions of the cloth are trimmed away, leaving a circle of screen cloth enclosed in a stiff metallic ring in which it is held under such tension as was imparted in the original stretch. The advance preparation of the screen cloth element as above described greatly facilitates the changing of screens and the assembling of a screen stack.

At the center of the screen cloth a hole is punched of such size as to pass over tension bolt 30. Surrounding this opening and on opposite sides of the screen are placed metallic washers 45 and 46, the outer edges of which are prevented from contacting the cloth by interposed elastic rings 47 and 48. The inner edges of the metallic washers are welded or brazed to the screen and to each other as at 49.

In assembling a screen stack, a screen cloth and its enclosing ring 42, prepared in advance as above described, is laid on supporting frame flange 31, tension bolt 30 projecting through the central opening in the cloth. An upper frame D or an intermediate frame C, as the case may be, is then placed in position with the lower flange 35 or 35' resting on ring 42. The screen ring and the two flanges are then brought into close engagement by an inwardly flaring clamping ring 50 of modified V-form (Fig. 7), this ring being hinged as at 51 and provided on the opposite side with a pair of lugs 52 and a drawbolt 53. It is desirable also to place an elastic grommet 54 in the base of the groove of the clamping ring as a dust seal.

The arrangement of an upper frame D on an intermediate frame C is brought about in the same manner and detailed description need not be repeated.

When thus positioned, the screen cloth is given its final tension by screwing down nut 55 and thus compressing an open coil spring 56, the lower end of which depresses the center of the cloth through the medium of a metallic washer 57 and an elastic washer 58. By sufficiently compressing this spring the cloth is drawn downwardly into at flatly conical form, which is considerably exaggerated in Fig. 1. Ordinarily the slope toward the center of the screen will be of the order of ⅛'' to ¼'' per foot radius.

At the point at which the circumferentially exposed portion of the screen cloth is adjacent the upper end flange 30 lying next below, it is highly desirable to provide the cylindrical shell (16 of element B or the corresponding cylinder of element C) with a ring 59 of channel section and to place in this channel a rubber O-ring 60 of such cross-sectional diameter as to project slightly above the upper face of the flange. This elastic ring provides a rounded contour to support the edge of the cloth when it is drawn down centrally in tensioning, and inhibits the cracking or tearing of the cloth which is almost certain to occur when the cloth is allowed to flex even very slightly over an angular and rigid support.

The combination of elements illustrated in Figs. 6 and 7 has proven to be highly effective in protecting the screen cloth from damage and thereby extending its useful life. One reason for the increased life of cloth is found in the extreme evenness with which the cloth is tensioned by mounting it in the form of a plane and then drawing it into the form of a cone, thus eliminating slack areas which would tend to whip. Again, the conical form into which the cloth is drawn is inherently stiffer and less subject to whip than a plane surface at equal tension. Again, the described method of tensioning makes it possible to stretch the cloth tighter than is possible with other methods of tensioning, thus reducing whip to the absolute minimum. And finally, such minute flexure as does occur takes place at the point of contact with rounded and elastic members, eliminating the line flexure which is highly adverse to screen life.

The tension spring 56 is an important element in the cloth depressing assembly as it automatically takes up slack which will develop in extended use of a cloth and thus greatly lengthens the intervals between manual adjustments of tension nut 55, to which access can be had only by removing overlying portions of the stack. It is desirable to make this spring as long as may be possible, to minimize the reduction in thrusting force following from a given extension of length.

So far as screen life is concerned, the point of the cone could as well be directed upwardly as downwardly, and thus the tensioning of the cloth could as well be produced by pulling or pushing it upwardly as by pulling it downwardly in the manner shown. This obviously would require reversal of the positions of channel 59 and O-ring 60. It is preferable, however, when used in apparatus of the Meinzer type, to direct the cone downwardly

rather than upwardly, for other reasons which appear below.

In the operation of a screen having the combined gyratory and tilting motion described in the Meinzer patent, the forces which produce movement of the feed over the surface of the cloth act tangentially (see arrows E in Fig. 5) with the result that a particle which remains on the upper surface of the cloth moves in a constantly widening spiral until it encounters the enclosing wall, around which it travels until it escapes through a delivery spout 61 communicating with an opening through the wall. This tendency to travel toward the edge of the cloth is resisted by directing the cone of the screen cloth downwardly, the feed being thus forced to travel uphill to escape. A highly useful control of time retention of the oversize on any given screen, under fixed conditions of rapidity and magnitude of gyration, may be exercised by varying the slope of the screen cone, an increase in slope increasing retention. This control may be utilized to increase the throughput capacity of the screen or to improve the sharpness of separation between oversize and undersize.

It should be understood, however, that the slope of the cone cannot be altered materially by varying the degree to which spring 56 is compressed, the attainment of minimum whip and consequent maximum screen life requiring that the screen be at all times tensioned as tightly as its inherent strength will permit. It is possible, however, to vary the degree to which the cloth is stretched prior to mounting it in the peripheral ring, and thus to provide more or less slack to be taken up in the final tensioning.

Because the feed travels outwardly over the screen, maximum utilization of the surface depends on feeding each screen centrally. The uppermost screen of the stack is fed in this location through any feed spout (not shown) while the return of the undersize from one screen to the center of the screen next below is effected by conical pans 36, the slope of which must be sufficient to cause gravitation to overcome the tendency of gyration to cause the solids to move outwardly.

Thus, in the assembly of Fig. 1, the upper screen of which is assumed to be fed centrally, the oversize from screen 40 passes out through delivery spout 61, the undersize falling onto pan 36 and passing by gravity to central opening 37 and through it onto screen 40' of the next finer mesh. The oversize from screen 40' passes out through spout 61' and, as this is the last screen in the stack illustrated, the undersize falls onto shield 29 and cone 17 and passes out through spout 61''. So far as discharge is concerned, element 17 might as well be flat, the steep inclination shown being to render it stiff enough to support the motor housing without flexing. The rigidity of attachment is increased by radius plates 19 extended between cone 17 and housing 18.

In some instances it may be found that the height of a feed return cone 36 having sufficient pitch to cause the solids to gravitate to a central opening produces a screen frame of excessive height. This difficulty may be experienced in the screening of very light and fluffy materials, or when the stack is composed of a number of screens of progressive mesh size, tending to produce a top-heavy stack.

In such instances a slightly pitched or flat pan 62 (Fig. 8) may be caused to deliver the material falling on it into a central opening 63 by providing its upper surface with vertical arcuate ribs or baffles 64, arranged to intercept the spiral path in which the particles move under the influence of gyration. Delivery at the center is made possible by the fact that the force moving the material circumferentially far exceeds that tending to move it radially.

In some instances it will occur that the throughput capacity of a stack of screens of progressive mesh size is limited by the tendency of a single screen of the stack to overload, causing the remainder of the screens to operate at less than full efficiency. This tendency may be due to the presence in the feed of an excessive proportion of particles of some desired size range, or to differences of shape or of specific weight between particles of different size.

In such cases it is possible to use two screens of the same mesh size in the stack, either in parallel with the load divided between them, as illustrated in Fig. 9, or in series with carry-over of incompletely separated material from one screen to that next below, as shown in Fig. 10. Even when a single separation only is to be made, it may be desirable to increase the effective screening surface without increasing the diameter of the screen, in either manner above referred to.

Referring to Fig. 9, which shows a stack of two screens only, a wide feed spout 65 delivers material centrally onto a screen 66 which has a downspout 67 fixed at its center and projecting above its surface. The cross-sectional area of the downspout should be about one-half that of the feed spout and the two should be concentrically arranged so that about one-half of the feed will be deposited on the screen while the remainder passes through the downspout. The lower portion of the downspout is fixed in a central opening of a conical pan 68 while the upper end may be threaded and provided with a nut 69 for tensioning the screen, a tension spring 70 being interposed as previously described.

A second screen 71, of the same mesh as screen 66, is located beneath pan 68 and is similarly tensioned by means of a tension bolt 72 projected upwardly from a second pan 73.

The oversize fractions from the two screens 66 and 71 are discharged through side outlets 74 and 75 into a common collecting conduit 76 while the undersize fractions falling on pans 68 and 73 are discharged through side outlets 77 and 78 into a common collecting conduit 79.

In this arrangement the screens function in parallel, each taking its share of the initial feed, and the side outlets of each pair deliver materials of approximately or, with careful adjustment, exactly the same size range.

In the series arrangement shown in Fig. 10, the feed spout 80 delivers material onto an upper screen 81 which is drawn toward a pan 82 by a tension bolt 83. A downwardly coned pan 84 having a central opening 85 is located next below, followed by a lower screen 86 of the same mesh as screen 81, this screen being drawn toward a pan 87 by a tension bolt 88.

The upper screen being assumed to be overloaded, the bypass outlet 89 will receive oversize containing more or less unseparated undersize, while the undersize passing through this screen onto pan 82 and from it to a side outlet 90 will be free from oversize.

The mixture passing through bypass 89 onto pan 84 is delivered onto the central portion of lower screen 86, by which the residual undersize is separated, this fraction falling onto pan 87 which discharges through side outlet 91 into a collecting conduit 92, this conduit thus receiving all of the undersize from both screens. The oversize, which has now passed over both screen, is delivered through side outlet 93 into an offtake conduit 94.

This arrangement, in which the two screens function in series, is particularly adapted to sharp fractionation, the first screen removing the bulk of the undersize and the second making a polishing cut. In each of these arrangements a pan receiving the undersize from a higher screen of coarser mesh may be substituted for the feed spout.

The device shown for assembling the screen sections is applicable to any screening mechanism using circular screens. The devices for premounting the cloth and protecting it from the destructive effects of whip are applicable in any screening mechanism, though they are particularly useful and valuable in apparatus having the

unique combination of movements described in Patent No. 2,284,671. The novel manner of mounting the motor and the arrangements illustrated in Figs. 9 and 10 appear to be restricted in utility to the type of device illustrated in that patent.

We claim as our invention:

1. In a screening mechanism in which two horizontally disposed screens of the same mesh are arranged in vertically spaced relation on a common support structure and said support structure and screens are subjected to a gyratory and progressive tilting motion; means for causing said screens to function in parallel, comprising: a receiving pan arranged beneath each of said screens; a spout discharging centrally above the upper screen; a vertical conduit disposed centrally through the upper of said screens and disposed symmetrically below and having a cross-sectional area less than that of the spout and affording communication through the upper screen and centrally to the space above the lower screen, whereby a portion of material fed via the spout is distributed centrally onto each of said screens; a separate outlet in the side of said supporting structure for each of said pans to receive screened material collected thereon; and a separate outlet in the side of said supporting structure for each of said screens to receive oversize material collected thereon.

2. In a screening mechanism, the combination of: two vertically spaced screens; a receiving pan between the screens; a conduit disposed centrally through the upper screen and the receiving pan; means for feeding material simultaneously onto the central area of the upper screen and through the conduit for feed onto the central area of the lower screen; and means for subjecting said screens to combined gyratory and tilting motion to cause radially outward movement of material on the screen; the screens being inclined toward their central areas to retard the radial movement of the material.

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