To all whom it may concern:

Be it known that I, Thomas Fewster Wilkinson, a subject of the King of Great Britain and Ireland, and a resident of Manchester, in the county of Lancashire, England, have invented certain new and useful Improvements in Separating or Grading Apparatus, of which the following is a specification:

This invention relates to a new or improved separating or grading appliance.

The new apparatus comprises a horizontal table, member, or plane surface which has motion imparted to it both horizontally and vertically while it maintains its own horizontality. Such a motion may conveniently be imparted to the table or the like by means of a crank rotating around a horizontal axis combined with means for maintaining the traverse of the table horizontal while any point on it follows a circular path in a vertical plane which corresponds to the path of the crank. Such means for preserving horizontality may comprise two parallel shafts running across the table under opposite ends and parallel to the crank shaft which is between them, like bell crank levers on such shafts, links from corresponding arms of the bell crank levers to support and to maintain the table in the proper horizontal position, and links connecting other like arms on the bell crank levers to insure simultaneous and like movements of the arms supporting the table. The table may be smooth and unperforated, or may be perforated or formed of sieving or screening material or fabric according to the material treated and the nature or degree of separating or grading required.

For grading a material the components of which differ considerably in specific gravities a smooth and unperforated surface or table may be used. The material to be separated is fed to the center of the table. During the first half of the ascent of the table from its lowest position the heavier material acquires a momentum which propels it upward and away from the surface of the separator when such surface loses its vertical speed as its horizontal movement reverses after passing half way through its ascending vertical movement; before the material falls the separator has moved farther in the reverse direction. Thus with a separator having a clockwise direction of rotation the heavier material is at short intervals being thrown up and falls back again to a point a little to the left of the point from which it is thrown up. It is thus rapidly transferred to the left hand end of the separating surface.

The lighter material having insufficient gravity to be similarly thrown up remains on the surface of the separator during the upper half of the rotation. Being light it has a tendency to float in the air or remain behind the point of the surface on which it has hitherto been carried when the horizontal traverse of the separator is reversed and the separator enters on the lower half of its revolution. Thus it is not carried back with the separator surface during this reverse horizontal movement and with a separator having the clockwise rotary motion described this light material is intermittently moved on to the right hand end of the separator. The materials and the speed of and length of the traverse of the separator surface must be appropriate to obtain the described result.

For treatment of some materials, however, the separating surface, while having the same motion imparted to it, may be formed of a suitable sieve, and the separation be effected by gradation through the sieve. A sieve having the motion described is extremely efficient. The overlites of the sieve will be moved to one end of the sieve surface or may even be separated and sent to opposite ends and there discharged and the throughs may be led away as desired.

Several separators of the type described may be arranged one below the other so that an upper separator may feed its materials or some of them into a lower separator. They are preferably so mounted that the complete apparatus is absolutely balanced.

The crank pin which imparts its rotary motion to the separator may be adjustable in length of throw, and this adjustment may be automatically effected during the working of the apparatus to increase the throw from its minimum at the commencement of dealing with a charge of material, to a maximum which appears most suitable to the material under treatment. This may conveniently be effected by mounting the crank pin to slide radially across its disk in a groove formed therein. The pin may be moved by a screw engaging with it. By ro
tation of the screw in one direction or the other the crank pin can be moved outward toward the periphery of the disk or inward to its center. The outer end of the screw has a star wheel adapted to be angularly moved by contact with a pin each time the star wheel passes it. Two such pins may be mounted on a sliding member so that either of them can be brought into the path of the star wheel on opposite sides or both be removed from such path. According to which pin is operative the crank pin will be intermittently moved inward or outward on its disk as the disk rotates. To prevent damage by overrunning, the screw may have its screw thread cut away at its ends, so that when the crank pin reaches either end of its adjusting path the screw shaft rotates idly on it. Springs press the crank pin toward the screw thread so as to cause engagement when the motion of the screw is reversed.

The accompanying drawings illustrate various forms of apparatus constructed according to my invention and will now be referred to. Figure 1 is a side view of an apparatus comprising a single separating or grading table. Fig. 1 is a diagrammatic view of the apparatus showing the table in different positions. Figs. 2, 3, 4, 5 and 6 are views of details used in the apparatus. Fig. 7 is a side view of the apparatus of Fig. 1.

Figs. 8, 9 and 10 are views from the side, the end, and in plan respectively of an apparatus comprising four grading and separating sieves so disposed and combined as to form a completely balanced machine.

Figs. 11, 12 and 13 are diagrammatic representations of other arrangements of separators.

Referring first to Figs. 1 to 7 inclusive, A represents a horizontal smooth and unperforated table. It is inclosed by a cover B, the center part of which has a feed hopper or opening C for entrance of the material to be graded. The table is supported by links D E which are hinged to and to the corresponding arms of crank levers E E secured to transverse rocking shafts F F. Secured to other corresponding arms of the crank levers are the coupling rods G H is a crank shaft provided with a variable throw crank pin J. This crank pin is journaled in a bracket H rigidly secured to the table A. The result of this construction and arrangement of parts is that, when the apparatus is working, every part of the table has a circular path in a vertical plane which corresponds to the circular path of the crank pin while the table is constantly maintained in its horizontal position. Fig. 1 shows the crank pin at different positions in its path, such positions being indicated by the numerals 1, 2, 3 and 4. Like numerals indicate the corresponding positions of the table, the positions 2, 3 and 4 being shown in broken lines and 2 and 4 being coincident. The motion of the material which is fed to a table having the described successive positions has been hereinbefore described.

J J indicate openings at the ends of the table A through which openings the graded or separated material overflows. K K are links hinged to yet further arms of the crank levers. These links carry a trunnion K' on which any required counterbalancing weights may be placed. L is a feed hopper secured to the stationary framing of the machine, its lower end being furnished with a feed roll L'. This feed roll is driven from a pulley H attached to the crank shaft H. M is a jockey pulley attached to an extension M' from the handle M' by which the feed is controlled. When the crank shaft has commenced rotating and the table A has begun to move effectively, the handle M' is pulled down, the jockey pulley M is pressed against the belt or band M, and the feed roll begins to rotate. Unless the jockey pulley is pressed against the band, the band is too slack to drive the feed roll. The feeding of the material can thus be deferred until the table A or its equivalent is moving sufficiently to deal with the material which is fed to it.

It is preferred to start the machine with the crank pin J at least so as to its effective maximum throw and to gradually move the crank pin away from the axis of the shaft so that the path of movement of the crank becomes larger and larger as the working of the apparatus proceeds. How this may be done is particularly illustrated by Figs. 2 to 6 of the drawings. The crank pin J is secured to a slide J which can slide in a radial slot in the plate N secured to the end of the crank shaft. This slide can be moved by the screw J to any position from the center of the plate N (which is coincident with the axis of the crank shaft) to its periphery. The screw J carries on its end a star wheel O. As this star wheel is carried around by the plate N its rays or teeth engage with one or other of two pins O O. These pins are mounted on a hand operated slide bar P (see also Fig. 1) so that either of them can be brought into the path of the star wheel. In Fig. 4 one such pin O is in the path of the wheel and rotates it in one direction; in Fig. 5 the other pin O is in the path of the star wheel and rotates it in the opposite direction. According to the direction of rotation given to the star wheel and its screw, the crank pin J will have its throw lengthened or shortened. The sliding bar can take up a central position in which neither pin turns the wheel. See Fig. 6.
The extent of throw given to the crank can be indicated by a scale W which is attached to the standard W. A is a bracket attached to the table A and embracing the standard W in such a way that it can move freely along and across the standard under the motion given to it by the crank. W is a slide which can move upon the standard but fits sufficiently tightly thereon to remain in any position in which it is placed. The slide W is moved by the bracket A and indicates on the scale the extent of movement of the crank.

Figs. 11, 12 and 13 illustrate diagrammatically various arrangements of a number of separating surfaces each operated to have the motion described in cooperative combination, indicating various ways of collecting and passing from one table to another or from one sieve to another the various separated or graded materials. Sieves are shown in the two lower elements of Fig. 12. The spouts or the like leading from one element to another are of such a nature as not to interfere with or prevent the motion of the elements from and to which they lead.

Figs. 8, 9 and 10 illustrate an arrangement of four cooperating sieves, tables or the like each having the described motion and which constitute a properly balanced machine. The lower sieve or table A is driven from and through the medium of appliances already described with reference to Figs. 1 and 2.

At each side of the stack of sieves at about half its height are two horizontally disposed rocking levers 5 and 6 mounted on the same axis. They rock in opposite directions. At each end of each horizontal rocking lever 5 is mounted a vertical rocking lever 7 and 8 and at each end of the horizontal rocking lever 6 is mounted a vertical rocking lever 9 and 10. The vertical rocking lever 7 is in front of the upper rocking lever 9 and the vertical rocking lever 8 in front of the vertical rocking lever 10. The upper end of the vertical lever 8 is provided with a hinged upwardly projecting bracket 13 which by a rod 11 is coupled to a similar bracket 14 on the upper end of the vertical lever 9. The lower end of the vertical lever 8 is provided with a hinged downwardly projecting bracket 13 which by a rod 11 is coupled to a similar bracket 14 on the lower end of the vertical lever 9. In the same way the upper end of the vertical lever 7 is provided with a hinged downwardly projecting bracket 15 which by the rod 12 is coupled to a similar bracket 16 on the upper end of the vertical lever 10.

The lower end of the vertical lever 7 is provided with a hinged downwardly projecting bracket 15 which by a rod 12 is coupled to a similar bracket 16 on the lower end of the vertical lever 10. The rods 11, 12 and 11', 12' at one side of the stack are connected with the corresponding rods at the other side of the stack by the transverse bars 17 upon which the separators rest.

The upper ends of the outer pair of vertical levers at each side of the stack are connected by a rod, the rod 18 connecting the vertical levers 7 and 8 in front of the machine and the rod 19 connecting the vertical levers 9 and 10 at the back of the machine.

The lower end of the vertical rocking lever 7 carried by one end of the horizontal lever 5 is connected to the bottom sieve as is also the lower end of the vertical rocking lever 10 carried by the opposite end of the other horizontal rocking lever 6. The bottom sieve has the desired motion communicated to it by the crank, and the motion given to such bottom sieve is communicated to the arms of the vertical rocking levers 7 - 10 and also to the horizontal rocking levers 5 - 6. The other sieves are so connected to the arms of the vertical rocking levers 7 - 10 as to result in a balance of motion. The connection is such that the top and bottom sieves move vertically in the same direction and longitudinally in the opposite directions. The second sieve from the top moves longitudinally with the top one but vertically in opposite directions; the third from the top moves vertically with the second but longitudinally oppositely and also moves vertically in the opposite direction but longitudinally in the same direction as the fourth and bottom sieve.

A convenient arrangement comprises four separators arranged vertically one above the other. The upper separator may be of the unperforated smooth plane surface type. The material to be graded by it, say broken grain, is fed to the middle of its upper surface. The solid grain particles and like heavy materials are transferred to one end of the separator; the chaff and bran particles are transferred to the other end and may be at once led away. The heavy particles may be led by a spout to the next separator below which contains a sieve.

The materials treated may be any suitable substances. The course of the material through the apparatus shown in Figs. 8, 9 and 10 is as follows. Each element is provided with a sieve. The coarse material is fed to the center of the upper sieve. The overtails of this sieve pass away through spout Q; the throughs of the sieve are carried by a spout Q' to the sieve in the element below. From the sieve of this element the overtails are led away through spout R; the throughs are led by spout R' to the sieve of the third element. The overtails of the third element are led away through spout S; the throughs are led through spout S' to the fourth element. From the fourth element the overtails are led away through spout T, and the throughs through spout U.
The material being graded or separated may be dried or may be treated by any gas or vapor by having hot or cold air or the required gas or vapor drawn through it or through the apparatus in which it is being treated.

Instead of being horizontal both longitudinally in the direction of travel of the material and transversely, the grading or separating surface or sieve need only be horizontal in the direction of travel of the material, that is as viewed in Fig. 1. From the point of view of Fig. 7 the table, sieve, or the like may be curved, or of a shallow V-shape or with undulations.

What I claim is:

1. A grading, separating or like appliance comprising a horizontal table, a bracket secured to the underside at about the middle of said table, a crank adapted to impart continuous, uninterrupted and complete circular motion in a vertical plane to said table and situated below the said bracket, the pin of the said crank being journaled in said bracket, and links so arranged that circular motion in a vertical plane is given to the table while it always retains a horizontal position, substantially as and for the purpose described.

2. A grading, separating or like appliance comprising a horizontal table, a bracket secured to the underside at about the middle of said table, a crank adapted to impart circular motion in a vertical plane to said table and situated below the said bracket, the pin of the said crank being journaled in said bracket, means for adjusting the distance of said pin from the center of said crank during the working of the appliance to regulate the extent of motion of the horizontal table in a vertical plane, and links so arranged that motion in a vertical plane is given to the table while it always retains a horizontal position, substantially as and for the purpose described.

3. The combination in a grading, separating or like appliance, of a series of horizontal tables located one above the other, a bracket secured to the underside and at about the middle of the lowest of the said tables, a crank adapted to impart circular motion in a vertical plane to said table and situated below the said bracket, the pin of the said crank being journaled in said bracket, links and levers so arranged that motion in a vertical plane is given to the table while it always retains a horizontal position, and levers connecting the said tables so that the directions of the combined vertical and longitudinal motion of any one table is different to the directions of the combined vertical and longitudinal motion of any other table of the series, substantially as and for the purpose hereinbefore set forth.

4. A separating or grading apparatus comprising a tray, means for imparting to said tray a continuous, uninterrupted and complete circular motion in a vertical plane, means for maintaining said tray in exact horizontalism during such circular motion whereby each point on said tray moves in a vertical circular path of the same diameter, and means for varying the amount of circular motion imparted to the tray.

In witness whereof I have hereunto set my hand in the presence of two subscribing witnesses.

THOMAS FEWSTER WILKINSON.

Witnesses:

John O'Connell,
Frank A. Heys.