This invention relates to separators of the spiral or helical type, in which materials of varying specific gravities and frictional characteristics are separated into different streams as they flow along the runaway.

In separators of this type, previously invented and patented by me, the runways have frequently progressed along a spiral or helical path, such runways being inclined downwardly and inwardly toward the axis of the separator in a straight transverse line.

While such separators have been successfully used for many years, it is nevertheless a fact that in separating coal and slate, the slate being the heavier material, has a tendency to first move inwardly toward the central axis and then, because of the steeper drop near the axis, to gain momentum and thus move crosswise or outwardly and into the path on the spiral runway where only coal is supposed to travel. Thus the materials in the old spiral separators do not travel downwardly in a truly constant spiral line. That is to say, the path of travel as viewed in plan, does not correspond to a circle centered on the axis of the separator.

The present invention is based upon my recent discovery that, if the runway surface of the separator instead of being inclined radially inward along a straight line as heretofore, is transversely curved, thus forming a helical valley, a decided improvement in the separation can be effected and for any given lump size of material handled, a predetermined zone or region of separation can be maintained along a substantially constant spiral line. Thus the material to be separated will follow a substantially constant helical path which, in plan view, will correspond substantially to a true circle.

One of the chief features of the present invention is the provision of a helical or spiral separator having such a transversely concaved runway. The location of the valley line or zone of separation, as measured transversely of the runway, will vary for different lump sizes of material, although the helical pitch or drop for a given turn around the helix or spiral may remain constant. For example, the helical line of travel for small size lumps of material on a runway of given longitudinal or helical pitch will be along the line of a circle of a relatively small diameter, as viewed in plan, while the line of separation for larger lumps will be along the line of a circle of larger diameter viewed in plan. A more detailed feature of the invention contemplates provision of guide means at the delivery end of the separator for guiding material coming from one side of the line of separation toward one discharge point and guiding material coming from the other side of separation to another discharge point.

This guide means will preferably be laterally adjustable so that for a given separator it can be varied to suit slight changes in the zone of separation when handling materials of slightly differing lump sizes. The above and other more detailed features of the invention will be fully apparent from the following detailed disclosure when read in connection with the accompanying drawings.

In the drawings—

Fig. 1 is a somewhat diagrammatic elevation illustrating the contour lines of one embodiment of the invention; Fig. 2 is a side elevation illustrating one turn of the separator runway; Fig. 3 is a plan view thereof; Fig. 4 is a fragmentary plan view showing one of the plate-like sections of the separator runway and a portion of the central supporting column; Fig. 5 is a section taken approximately on line 5—5 of Fig. 4; Fig. 6 is a similar section illustrating a modified construction; Fig. 7 is a plan view of one of the runway plates in flat condition before being warped or formed to produce the concave runway surface; Fig. 8 is a fragmentary plan view of the delivery end of the separator showing adjustable guide means for directing differing materials to separate storage points; Fig. 9 is an end elevation thereof, and Fig. 10 is an enlarged detail of the adjustable guide means.

Referring in detail to the drawings, 10 represents a central supporting post, to which may be secured suitable supporting rods or brackets 11, on which will rest a plurality of plate-like sections 12, which are overlapped and riveted as at 13 or otherwise secured to one another, so as to form a substantially continuous helical runway.

Hereofore, the runways of spiral separators have been so disposed that the runway surface, as viewed from any substantially radial vertical plane, will be inclined in a straight line downwardly and inwardly at an angle, for example, as indicated by the broken lines a—b in Figs. 1 and 5. This straight line radial inclination of the runway toward the axis of the helix is now generally known in the art as the "flare".

Such a straight flare on the runway surface results in a very rapid drop of the material particularly in the zone nearest the axis thereof. According to the present invention, instead of having a straight inward flare, I provide what
may be termed a "transversely concaved flare", such as shown on an enlarged scale in Fig. 5. Such concavity of the runway at various points along the length of the runway is illustrated graphically in the diagrammatic view of Fig. 1. In this figure, the straight broken lines a--b correspond to the old form of straight flare runway surface. The line a--b at the top of Fig. 1 may be considered as lying along a horizontal center line of Fig. 3 passing through the axis of the post 10.

In the novel separator of the present invention I provide a runway having a concave supporting surface, such as illustrated, forming a valley between the inner and outer edges of the runway. For a given lump size of material handled, there will be a substantially constant helical zone or line of separation, such as indicated by the dotted line c--c in Figs. 4 and 5, or by the dotted circle c in Fig. 3. These lines c represent the lowest point in the valley of the runway. The location of this valley or zone of separation will vary for different sizes of material. For example, for separating materials of the relatively large lump size known as "egg", the zone of separation may be considered as taking place along the line c--c. Assuming that a larger lump size is to be handled, the low point in the valley or zone of separation will lie at a greater distance from the vertical axis of the separator, for example, along the helical line indicated at d--d. In the improved separator, therefore, the runway surface is depressed between its inner and outer edges, thus forming the concave surface a--c--d--b of Fig. 5. This cross-sectional configuration provides what I term a valley which corresponds to the zone or line of separation. This valley or helical zone of separation will be located at different predetermined radial distances, depending upon the lump size of material being handled. That is to say, that for a separator adapted to handle small size lump material, the valley will be located nearer the center or axis of the separator than will be the case for a separator adapted to handle large size lump material.

In operation when the separator is used for ridding coal of slate initially mixed therewith, the slate or heavier material traveling along the runway will slide or move inwardly toward the axis, and the coal or lighter material will work its way outwardly and eventually travel in a path along the outer side of the line or zone of separation. This uniformity of helical travel is a novel functional characteristic which could not be attained by my old types of separators which had a straight line inward flare.

The difference between the action of my old separators and the novel one of the present invention will be apparent from reference to Fig. 5, when taken with the following explanation.

The inner part of the concave surface of the improved runway provides an upward inclination on one side of the line c--c, while in the old form of straight flare the runway surface from the inside of the said line c--c was inclined downwardly toward the axis of the separator. The inclination of the surface of the runway outwardly from the line of separation c--c in the case of the concaved runway is relatively steeper than the old straight flare runway, as will be apparent by comparison of the curved portion c--d--b of Fig. 5 with the straight line portion a'--b' corresponding to the old straight inward flare.

Now, in my old straight inwardly flared helical runways, the fact that the grade of the helix was steepest near the center coupled with the fact that the runway was inclined toward the axis caused the large particles to gain momentum and cut crosswise and enter the outer coal stream instead of continuing downward in a true helical path. This difficulty is overcome by the present invention by the relatively simple yet heretofore unobvious expedient of forming the runway with a concaved flare above described.

Tests, which I have made show that with such a concaved flare the oblique cross-flow of slate is overcome and thus the separation on my new separator takes place along a substantially constant helical path for any given lump size.

With the improved runway having the concaved flare, the upwardly curved or inclined surface on the inner part of the separator runway will result in a slowing up of the slate travel. At the same time, it will slightly retard the coal travel. The net result of this combined with the action of gravity, friction and centrifugal force will, for a given helical pitch, give the materials a greater time interval to bring about the desired separation into different streams, as they travel helically downward along the runway surface. Thus, it is clear that, as compared with the old type of straight line flare, the novel concave flare of the present invention results in an important functional improvement.

The concave runway is produced by taking relatively flat plates, such as shown in Fig. 7, and bending or warping them to their desired concave curvature. However, in some cases, instead of having a curved concave configuration the concavity may be in the nature of oppositely inclined straight surfaces. Such a modification is shown in detail in Fig. 6.

While the concave runway referred to will usually be formed of a plurality of bent plate-like sections, with the lower edges of one plate overlapping the upper edge of the next lower plate, the plates may be arranged with their adjacent edges abutting and united by flush seam welds. Or, the sections may be formed of cast metal of the concave form described.

At the lower discharge end of the separator, I preferably provide adjustable guide means adapted to direct the inner flowing stream of slate to one storage point and the outer flowing stream of coal to another point. This guide means is preferably mounted in such a manner as to permit of lateral adjustment to suit slightly different lump sizes to be handled on a given concaved runway.

By way of illustration, I have shown such an adjustable mounting in Figs. 8 to 10, wherein there is a block 14 having slots 15 therein through which pass fastening bolts 16, which extend through the plate to the lowermost section of the runway. It will be understood that, by loosening the nuts, the block 14 can be adjusted laterally so as to position this guide device as a whole to suit different lump sizes of material handled. The guide element of this device in the embodiment illustrated is in the form of a rod 18 extending substantially tangent to the line of separation, for example, the line c--c. To permit of still finer adjustment, the rod 18 may be mounted eccentrically on an elongated bolt 19. Thus, a rough lateral adjustment can be made by a shifting of the block 14 and a finer or more precise adjustment may be...
secured by turning the rod 18 about its eccentric bolt mounting 19. Below the guide rod 18, I provide a partition 20 serving as a separating barrier to prevent intermixture of the coal and slate, as it drops into the chute 21 to be led to suitable storage receptacles, not shown. The chute 21 may be conveniently secured at its end to the block 14, as shown.

While I have described quite precisely certain specific embodiments of the invention illustrated it is to be understood that various modifications and substitution of equivalents may be made by those skilled in the art without departure from the invention as defined in the appended claims.

What I claim is:

1. A separator of the character described comprising a stationary helical runway of fixed vertical pitch sufficient to cause material to slide thereon by gravity and having a supporting surface depressed downwardly from its inner edge for a substantial distance therefrom and thence upwardly to an outer edge above the level of the inner edge to form a helical valley of concave upward flare effective to separate materials of a given lump size but of different specific gravities and frictional characteristics along a helical zone or line of predetermined pitch and diameter.

2. A separator of the character described comprising a stationary helical runway of fixed vertical pitch sufficient to cause material to slide thereon by gravity and having a supporting surface depressed downwardly from its inner edge for a substantial distance therefrom and thence upwardly to an outer edge above the level of the inner edge to form a helical valley of concave upward flare effective to separate materials of a given lump size but of different specific gravities and frictional characteristics along a helical zone or line of predetermined pitch and diameter.

4. A separator of the character described comprising a stationary vertical post, a stationary helical runway of fixed vertical pitch sufficient to cause material to slide thereon by gravity, secured at its inner edge to said post and having a separating surface depressed downwardly from its inner edge for a substantial distance therefrom and thence upwardly to an outer edge above the level of the inner edge to form a helical valley of concave upward flare effective to separate materials of a given lump size but of different specific gravities and frictional characteristics along a helical zone or line of predetermined pitch and diameter.

5. A separator of the character described comprising a stationary helical runway of fixed vertical pitch sufficient to cause material to slide thereon by gravity and having a supporting surface depressed downwardly from its inner edge for a substantial distance therefrom and thence upwardly to an outer edge above the level of the inner edge to form a helical valley of concave upward flare effective to separate materials of a given lump size but of different specific gravities and frictional characteristics along a helical zone or line of predetermined pitch and diameter.

6. The separator of claim 1 in which said separating surface is concaved in a radial direction on a smooth unbroken curve.

7. The separator of claim 1 in which said separating surface is depressed to an angle extending helically at a distance from the inner edge of said surface and then extends upwardly to the outward edge thereof.

8. The separator of claim 1 in which said separating surface is made of a succession of plates having the lower edge of one plate overlapping the upper edge of a successive plate.

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