No. 753,592. PATENTED MAR. 1, 1904.

A. LANGERFELD.

SEPARATOR.

APPLICATION FILED JAN. 6, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

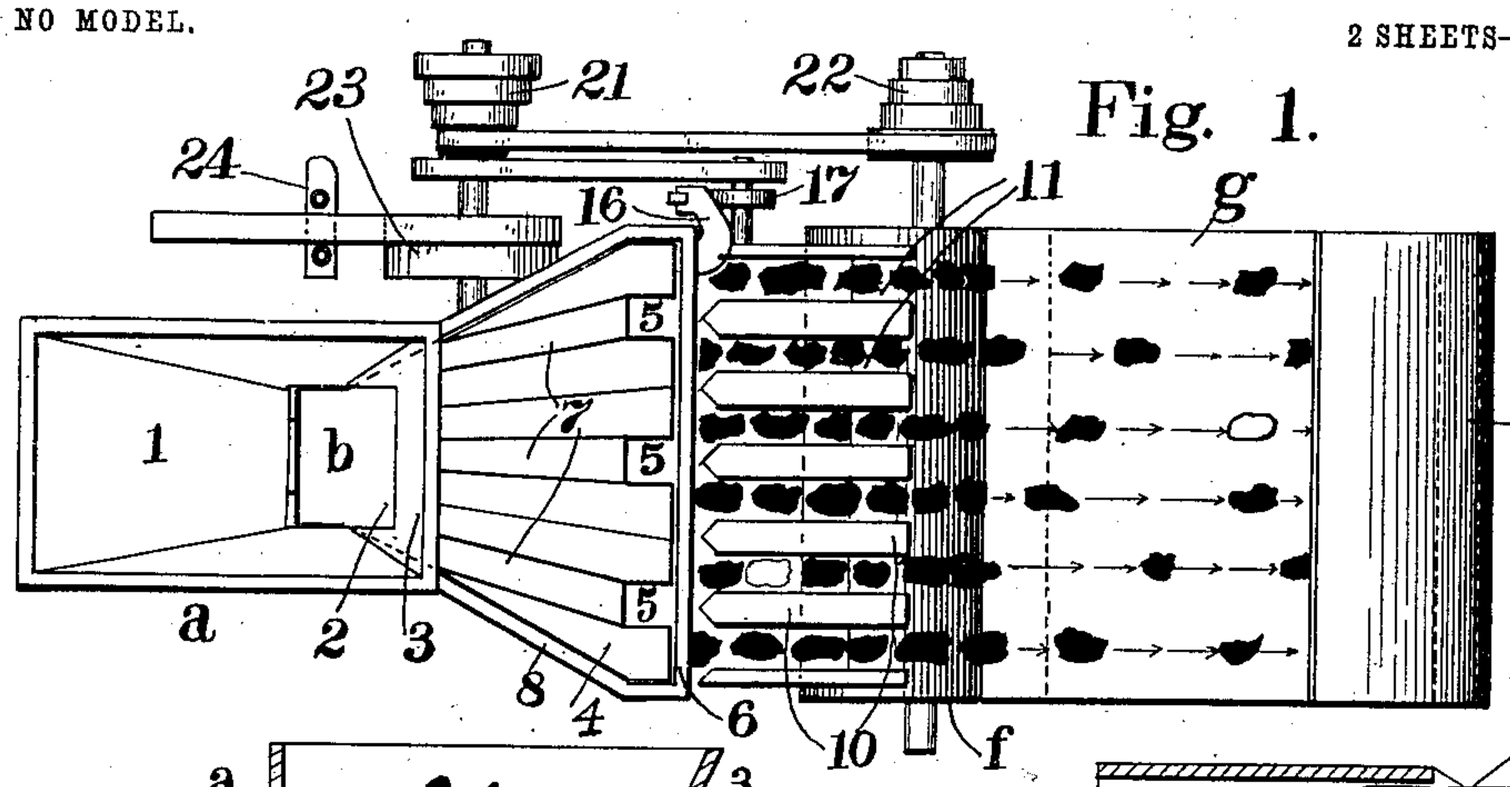

Fig. 1.

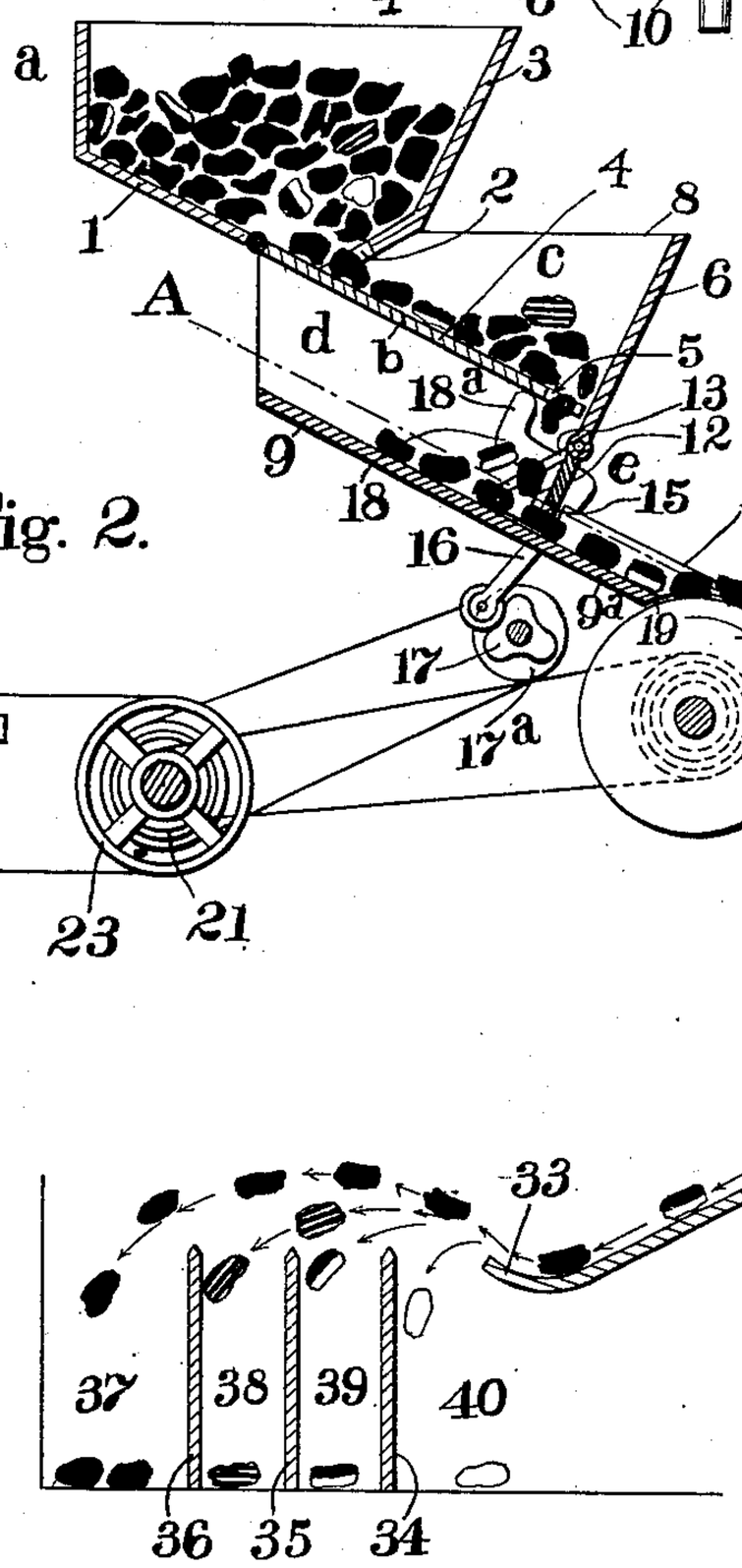

Fig. 2.

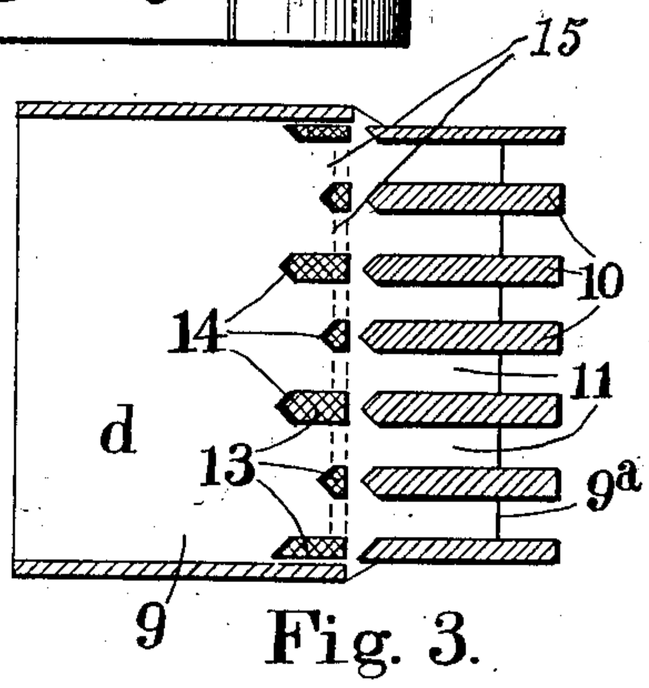

Fig. 3.

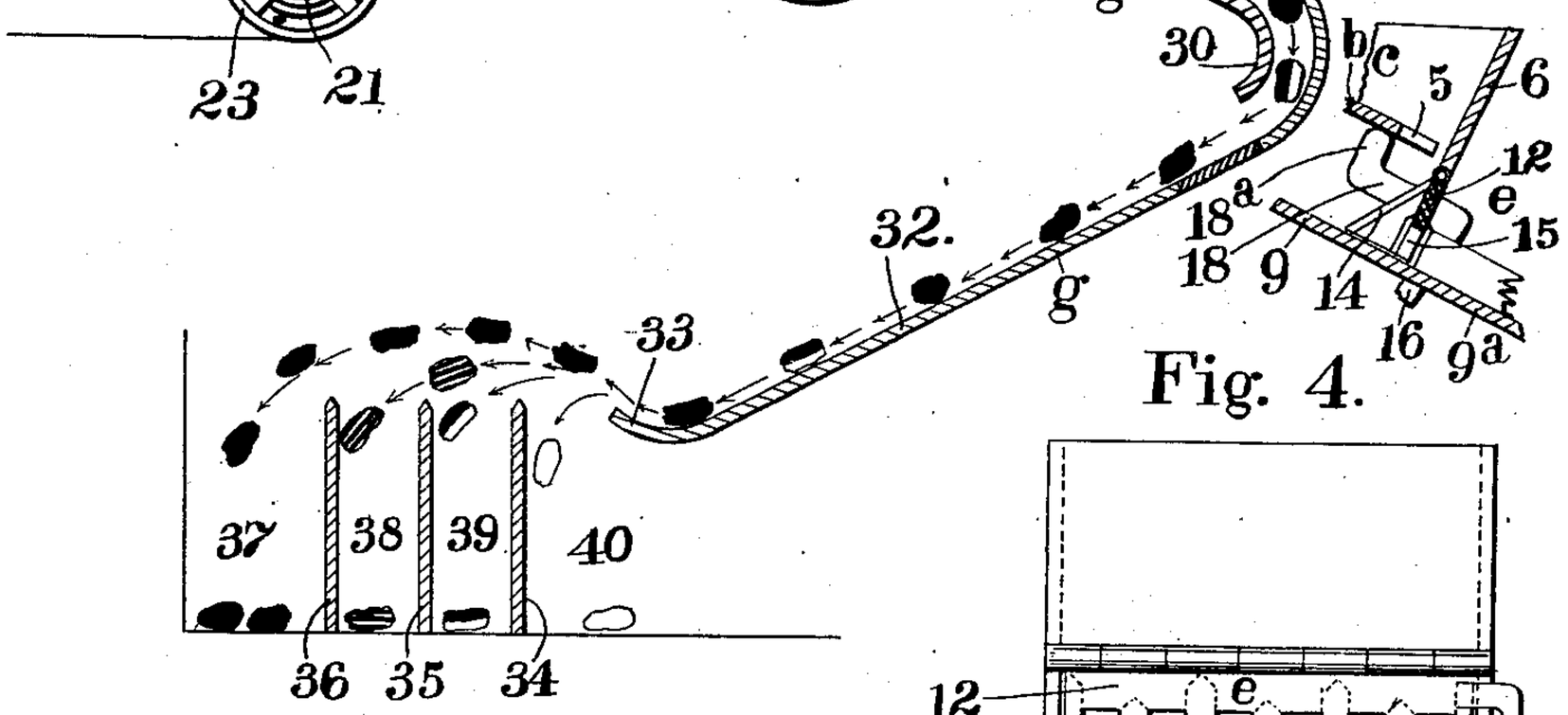

Fig. 4.

Fig. 5.

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 6.

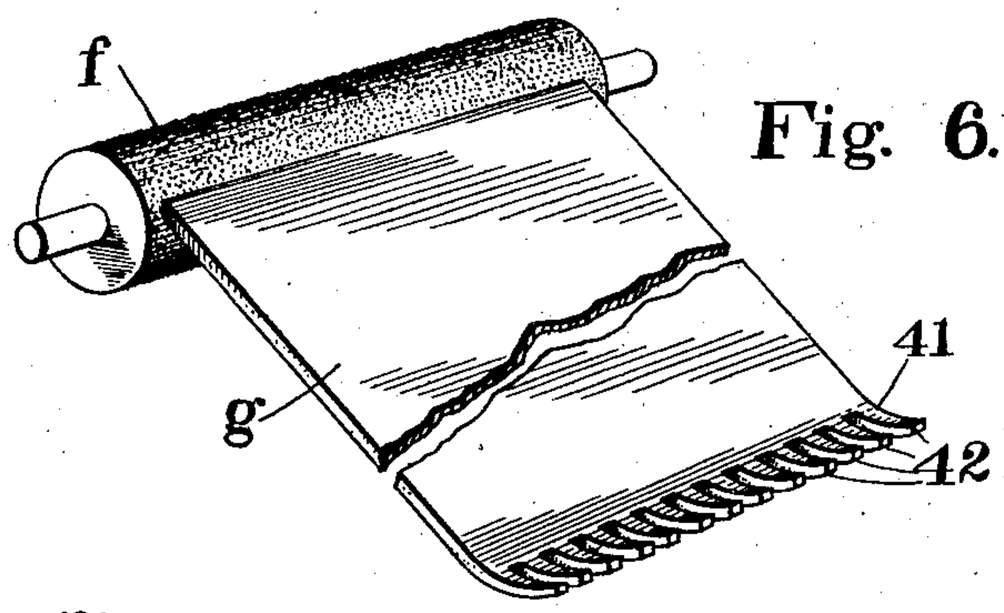


Fig. 7.

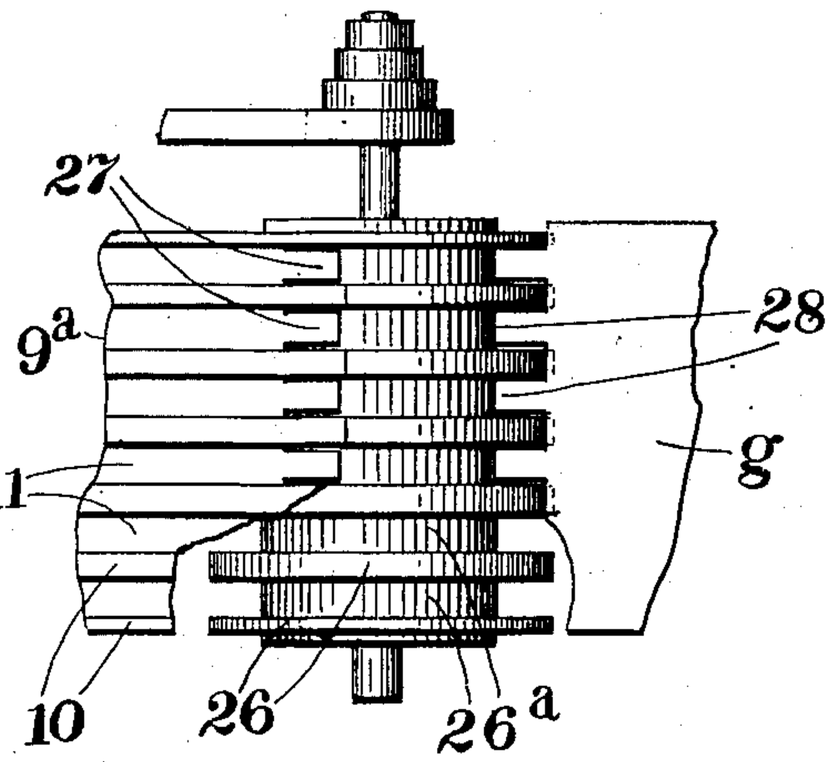


Fig. 8.

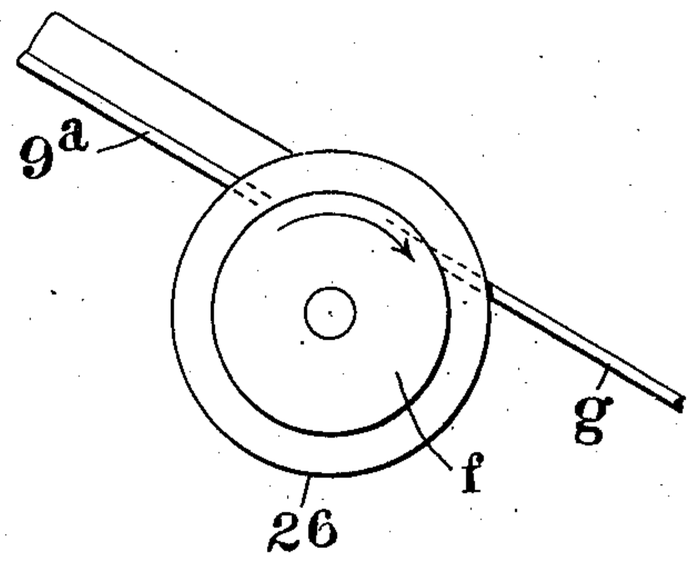
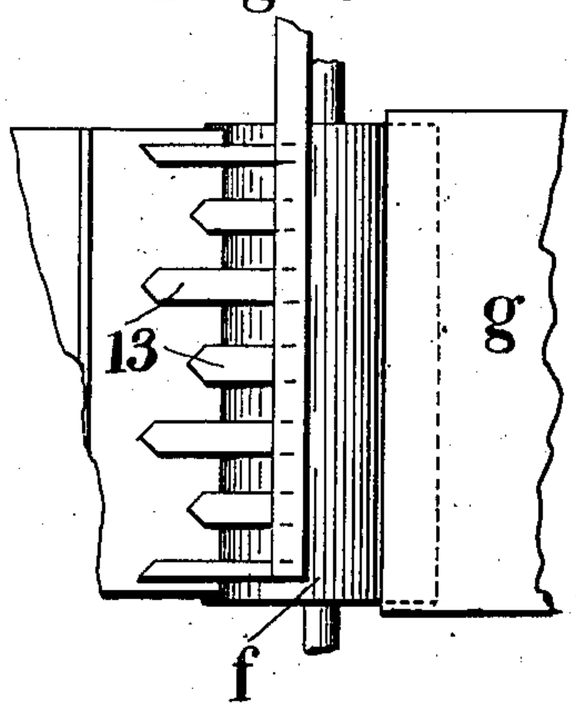


Fig. 9.



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No. 753,592. Patented March 1, 1904.

UNITED STATES PATENT OFFICE.

ARTHUR LANGERFELD, OF SCRANTON, PENNSYLVANIA.

SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 753,592, dated March 1, 1904.

Original application filed April 3, 1899, Serial No. 711,582. Divided and this application filed January 6, 1903. Serial No. 138,036. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR LANGERFELD, a citizen of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented certain new and useful Improvements in Separators, of which the following is a specification.

This invention relates to improvements in separators of the kind shown in my application, Serial No. 711,582, filed April 3, 1899, of which this application is a division. In said original application I have shown a separator and various forms and modifications thereof adapted for the complete separation of mixed masses of lump material, the pieces of which vary in their specific gravities in the nature of their surfaces or in their forms or in any or all of these attributes. Such a complete separator comprises three primary elements—namely, a declivous frictional differentiating slide inclined at such an angle to the horizontal plane that the pieces of material separately fed thereto will pass down thereover by gravity slow enough to allow each piece to acquire a velocity peculiar to its properties, which velocity is determined by the specific gravity and frictional resistance of the piece on said surface, means for feeding the pieces of material apart from each other to the slide, so that collisions between the pieces while upon the slide will be averted, means for inverting the pieces of material during their passage down the slide in order to subject the pieces to the retardative action of their opposite sides and a projector at the lower end of the slide whose surface is gradually elevated relatively to the adjoining part of the slide and from which the material flies or projects toward one or more separating-partitions arranged to divide the projected stream of pieces.

The present application relates particularly to the means for feeding the pieces of material apart from each other to the slide and to certain other features of construction illustrated and described in said original application, but not specifically claimed therein.

Machines made in accordance with my invention are particularly adapted for separating the natural product of anthracite-coal mines, and I shall for the purpose of illustration describe the invention as applied to the separation of such product, although it will be understood, of course, that the machines are equally applicable to the separation of various other mixed materials.

The product of anthracite-coal mines consists mainly of a mixture of pure coal, partly-pure coal, (called "bone,") composite pieces of coal and rock, and pure rock, usually referred to as "slate." By means of the feeding mechanism herein described the pieces of material from a mixed mass of this description are fed separately and automatically to the slide. Owing to the manner in which the pieces are fed to the slide, spaced apart from one another laterally and longitudinally of the slide, each piece is treated as an individual, unaffected by the other pieces during its course down the slide, and collisions which would destroy the peculiar velocity of each colliding piece are prevented. A collision, for instance, between a fast-moving piece and a slow-moving piece would retard the former and accelerate the latter, and the resultant speeds of such pieces would not be speeds peculiar to their properties, and therefore a perfect separation cannot take place unless such collisions are averted by so feeding and spacing the pieces apart from each other that the slowest-moving piece will not be overtaken upon the slide by a succeeding piece having the fastest speed and by so feeding the material that lateral collisions cannot take place. The inversion of the material during its passage down the slide brings the opposite sides of each sliding piece in contact with the slide, so that the speeds of such pieces are affected by the retardative natures of their opposite sides. Composite pieces—for instance, such as coal having a layer of slate on one side or slate having a film of coal on one side—will by reason of this inversion acquire velocities which will be less than that of pure coal and greater than that of pure slate, whereas if not inverted and allowed to move over the entire length of the slide on their slate sides or on their coal sides the velocities would

approximate that of the slate or coal, as the case might be, and a perfect separation could not take place.

In the accompanying drawings, which illustrate the invention, Figure 1 is a plan view of a separator embodying my improvements and having a slide in two sections sloping in opposite directions. Fig. 2 is a vertical section through the same. Fig. 3 is a section on the line A A of Fig. 2, showing the arrangement of the teeth and blades upon the rake or ranging device and the channels into which the pieces of material are directed by said ranging device to form single-piece files. Fig. 4 is a rear view of the distributing-hoppers, showing the rake or ranging device for directing material into the channels. Fig. 5 is a vertical section through Fig. 4, taken on a line passing between adjacent teeth upon the ranging device. Fig. 6 is a perspective view of a slide, showing fingers at its lower end and a feed-roller with a rough surface. Figs. 7 and 8 are plan and side views, respectively, of a feed-roller having channels registering with the channels in the feed-chute and forming continuations thereof; and Fig. 9 is a plan view of a modification, showing the feed-roller and ranging device brought together, the channeled feed-chute being omitted.

In carrying out my invention as applied to the separation of coal the material is first passed through screens and graded according to size. The pieces of material should be of a size as nearly uniform as practicable, the largest pieces being of a size which will pass freely through the several passage-ways in the feeding mechanism and the smallest pieces being more than one-half as large as the largest or more than one-half as wide as the feed-channels, so that two pieces of material cannot enter the feed-channels together. The material thus sized is placed within a receiving-hopper *a*, Figs. 1 and 2 of the drawings, which hopper is provided with an inclined bottom 1 and one or more discharge-openings 2, this discharge-opening in the drawings being at the base of the rear side 3 of the hopper. Below said opening and hinged to the bottom 1 is an inclined distributing-chute *b*, the forward part 4 of which extends into a distributing bin or hopper *c* and is provided at its lower end with a series of discharge-notches 5. The lower end of the distributing-chute is arranged close to the side 6 of the distributing-hopper, which side forms a fixed stop for the coal passing down over the distributing-chute. The distributing-chute is provided with diverging ridges 7, as indicated in Fig. 1, for the purpose of directing the material to the notches in cases where the distributing-chute is wider than the discharge-opening in the receiving-hopper; but these ridges may be omitted. Suitable means are provided for agitating the distributing-chute, so as to work the material out through the limited discharge-opening 2 and downwardly through the discharge-notches 5.

Beneath the distributing-chute *b* is a secondary distributing-hopper *d*, the sides of which may be, as shown, the sides 8 of the primary distributing-hopper *c*. The inclined bottom 9 of the secondary hopper is continued downwardly beyond the hopper, as shown at 9^a, the parts 9 and 9^a forming a feed-chute, the upper part 9 of which has a plain surface, while the lower part 9^a has arranged thereon a series of parallel ridges 10, evenly spaced apart, leaving intervening channels 11 of sufficient width to receive the largest pieces of material.

Extending transversely of the secondary chute and hinged to the stop-plate 6 is a rake or ranging device *e*, consisting of a cross-head 12, having thereon a series of teeth 13 in line with the ridges 10, and extending down to the surface of the chute and in front of every alternate tooth is a ranging-blade 14. This rake or ranging device is swung to and fro by suitable means, and the material which is received upon the upper part 9 of the feed-chute is directed by the teeth upon the ranging device into the channels 11 between the ridges 10, and thus arranged in single-piece files. By making every second tooth longer than the intermediate teeth it will be seen that long pieces of material will not lie across adjacent teeth and choke the passage-ways 15, but will be turned by the elongated teeth or ranging-blades and will slide into the channels. The distributing-chute and ranging device may be moved or agitated by any suitable means, such as one or more arms 16, connected to the ranging device and operated by a cam 17 upon a shaft having a driving-pulley 17^a. As shown in the drawings, an arm 18 is secured to the side of the hinged ranging device and has an offset end 18^a, upon which the end of the distributing-chute rests.

The lower end of the channeled feed-chute meets the surface of a transversely-arranged feed-roller *f* at a point 19 above its axis at such an angle to the roller that the latter will prevent the pieces of material from sliding onto the roller; but the inclination of the part of the roller above the chute is slight enough to permit the pieces of material in the single-piece files to mount the roller as it turns, thus causing the rows of pieces to travel or feed only as fast as the surface of the roller travels. By properly regulating the speed of the roller the pieces of material from the several single-piece files within the channels may be fed one by one to an adjoining section 20 of a differentiating slide *g*.

The feed-roller is preferably driven by separate driving-belts in order that it may not be shaken by the vibrating parts of the feed mechanism. As shown, the roller is operated by cone-pulleys 21 and 22, by means of which the speed may be varied. For finer regulation

of speed tapering pulleys may be substituted for the stepped cone-pulleys shown. All of the mechanism may be conveniently driven from a common shaft having tight and loose pulleys 23, and the mechanism may be stopped and started by a suitable belt-shifter 24.

The supply of material to the feed-roller is automatically controlled by the arrangement of mechanism above described. As the weight of the pieces of material in the feed-channels rests principally upon the feed-chute and only lightly against the surface of the roller and as the mass of pieces within the secondary distributing-chute rests partly upon the bottom of the chute and partly against the ranging device the flow of pieces through the channels will stop whenever the roller and the ranging device are stopped. The agitation of the distributing-chute *b* should also be stopped at the same time, so that the material will not accumulate in the hoppers *c* and *d*. As the distributing-chute and ranging device are in the drawings operated by a common agitating device, the stoppage of one necessitates the stoppage of the other. Should the secondary distributing-hopper *d* become choked and partially filled, the material accumulated within said hopper will raise the distributing-chute *b* off of the arm 18, and as the agitation of the chute will then cease the further feeding of the coal through the discharge-notches 5 will be stopped. This in turn will stop the feeding of coal through the discharge-opening 2 of the hopper *a*. As the secondary distributing-hopper *d* is open at its upper end, as shown, and the hopper *c* is also open at the top, any obstruction occurring within said hoppers may be readily removed. The material also cannot be delivered to the feed-roller any faster than the surface of said roller travels. If, for instance, the feed-roller should stop or travel very slow, the material will accumulate in the secondary distributing-hopper *d* and lift the distributing-chute *b* off of the agitating arm, thereby stopping the flow of material to the hoppers.

The surface of the roller is preferably roughened or pronged to engage the pieces of material and carry them positively over its center, although a comparatively smooth surface will answer the purpose. A roller with a roughened surface is illustrated in Fig. 6. Such a surface results in more uniform feeding than where a smooth surface is employed.

To make sure that the pieces will remain spaced apart laterally after landing on the roller, the roller may, however, as shown in Figs. 7 and 8, be provided with annular ridges 26, arranged in line with the ridges 10, and thus forming annular channels 26^a in the roller in line with the channels 11. The bottoms of the channels 11 then have tongues 27, which project into the channels 26^a in the roller. The channels in the roller thus form continuations of the feed-channels 11. With a roller of this construction the upper end of a slide-section is provided with tongues 28, which enter the grooves, as shown in Figs. 7 and 8.

The part 9^a of the feed-chute may be omitted and the ranging device brought close to the feed-roller, as shown in Fig. 9, in which case the teeth upon the ranging device are preferably elongated, as shown in said figure, to form channels between them in which the pieces may be arranged in single-piece files. When so arranged, it is better to reciprocate the ranging device transversely in order to prevent clogging between the blades.

The upper end of the slide-section adjacent to the feed-roller meets the roller a little below the top thereof, either tangential to the surface of the roller a little below the tangential line or intersecting the roller at a small angle, as illustrated in Figs. 7 and 8.

As plainly shown in Fig. 1, when the feed-roller is rotated the pieces from each of the single-piece files are transferred one by one onto the slide. Each piece is given substantially the same impetus in passing from the roller to the slide, but it may be that the pieces will start upon the slide with little or no impetus from the roller, as where the slide is tangential to the roller; but in any event the impetus given to all of the pieces will be substantially the same. The speed of the roller is so regulated that a piece of material having the slowest speed upon the slide will not be overtaken by a succeeding piece having the highest speed. Collisions between the pieces issuing from the same channel therefore cannot take place, and as the channels are spaced apart transversely of the slide by the ridges on the feed-chute collisions between pieces issuing from adjoining channels cannot take place. The pieces during their descent therefore are spaced apart from each other both lengthwise and transversely of the slide.

The slide may consist of a single section or any desired number of sections, and the sections may be variously arranged according to convenience and fineness of the separation desired.

In Fig. 2 I have shown a slide in two sections with provision for inverting all of the material during its passage down the slide.

In Fig. 2 the sections slope in opposite directions and the lower end 30 of the upper section 20 is turned toward the lay of the lower section, while the upper end 31 of the lower section 32 is turned gradually around the end 30 and toward the lay of the upper section, the arrangement being such that the material in passing from the upper to the lower section will be inverted, as more fully described in my application hereinbefore referred to. Pieces of material differing in the retardative nature of their opposite sides—as, for instance, composite pieces of coal and

slate—will thus be subject to the frictional resistance of their opposite sides upon the slide and will acquire velocities different from the velocities they would acquire if not inverted. Upon reaching the lower end of the slide the pieces, having acquired velocities peculiar to their individual properties, pass over a curved projector 33 to various distances, according to their acquired speeds. In separating coal, for instance, pure coal, which acquires the greatest speed, will fly the farthest and, passing over the separating partitions 34, 35, and 36 adjacent to the projector, will enter the pocket 37. Impure coal or bone, which acquires a slower speed, will enter the pocket 38. Composite pieces of slate and coal will enter the pocket 39, and pure slate, which travels the slowest, will not pass over any of the separating partitions and will drop from the end of the projector into the pocket 40.

In Fig. 6 the projector 41, arranged at the lower end of the slide, is notched, as shown, forming a series of fingers or tongues 42. The object of this formation is to provide openings in the projector, through which dust, water, and chips will drop instead of accumulating in the hollow of the projector, where they would obstruct and retard the pieces of material.

My improved feeding means may be employed to great advantage in conjunction with differentiating slides which are not provided with either the inverting means or a projector or in which one of these elements is omitted; but for the complete separation of such material as the output of anthracite mines I prefer to employ inverting means and the projector in connection with a single-piece feeding mechanism.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a separator for lump material, a declivous slide, one or more separating-partitions at the lower end of said slide, devices for ranging the material in single-piece files, spaced laterally apart from each other at such distances as to preclude contact on the slide between the pieces from adjacent files, and means for delivering the pieces of material separately from the files onto the slide.

2. In a separator for lump material, a declivous slide, one or more separating-partitions at the lower end of said slide, devices for ranging the material in single-piece files, spaced laterally apart from each other at such distances as to preclude contact on the slide between the pieces from adjacent files, means for delivering the pieces of material separately from the files onto the slide, and means for automatically regulating the supply of material to said ranging devices.

3. In a separator for lump material, a declivous slide, one or more separating-partitions at the lower end of the slide, a feeding device having a traveling surface at the upper end of the slide and arranged to deliver material onto the slide, and a channeled feed-chute arranged to deliver material onto said surface, the channels on said chute being spaced laterally apart from each other at such distances as to preclude contact on the slide between the pieces of material issuing from adjacent channels.

4. In a separator for lump material, a declivous slide, one or more separating-partitions at the lower end of the slide, a feeding device having a traveling surface at the upper end of the slide and arranged to deliver material onto the slide, a channeled feed-chute arranged to deliver material onto said surface, the channels on said chute being spaced laterally apart from each other at such distances as to preclude contact on the slide between the pieces of material issuing from adjacent channels, and means for automatically delivering the material into said channels.

5. In a separator for lump material, a declivous slide, one or more separating-partitions at the lower end of the slide, a feeding device at the upper end of the slide having a traveling surface and arranged to deliver material onto the slide, a channeled feed-chute arranged to deliver material onto said surface, and a movable rake arranged above said feed-chute, close to the surface thereof, and adapted to arrange the material in single-piece files spaced laterally apart from one another.

6. In a separator for lump material, the combination with the slide, one or more separating-partitions, and the feeding device having a traveling surface, of a feed-chute meeting said feeding device, said feed-chute having a plain upper portion and longitudinal ribs on its lower portion, and a movable rake arranged over said plain portion and having teeth in line with said ribs.

7. In a separator for lump material, the combination with the slide, one or more separating-partitions, and the feeding device having a traveling surface, of a feed-chute meeting said feeding device, said feed-chute having a plain upper portion and longitudinal ribs on its lower portion, and a movable rake arranged over said plain portion and having teeth in line with said ribs, the alternate teeth on said rake projecting longitudinally of the chute to a greater distance than the intermediate teeth.

8. In a separator of the kind described, feeding means for spacing the pieces of material laterally and longitudinally apart from each other comprising a movable distributing-chute having notches at its lower end, a fixed stop-plate extending across the end of said chute, means for vibrating said distributing-chute, a feed-chute arranged below the distributing-chute, and means for arranging the pieces of material in single-piece files on said feed-chute.

9. In a separator of the kind described, feeding means for spacing the pieces of material laterally and longitudinally apart from each other comprising a receiving-hopper having one or more discharge-openings, a movable distributing-chute beneath said openings, said chute having notches at its lower end, a fixed stop-plate extending across the lower end of the distributing-chute, a feed-chute arranged below said notches, and means for ranging the pieces of material in single-piece files on said feed-chute.

10. In a separator of the kind described, a feed-roller having annular ribs thereon forming intervening channels spaced laterally apart at such distances as to preclude contact between the pieces in adjacent channels, a feed-chute having longitudinal ribs in line with the ribs on the roller and having tongues at its lower end projecting into the channels on the roller, and a slide having tongues at its upper end projecting into the channels on the roller, the channels on said roller being spaced laterally apart at such distances as to preclude contact between the pieces of material passing therefrom onto the slide.

In testimony whereof I affix my signature in presence of two witnesses.

ARTHUR LANGERFELD.

Witnesses:
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KATE CAMPBELL.