Oct. 19, 1926. 1,603,997

H. M. SUTTON ET AL

PROCESS AND APPARATUS FOR DRY SEPARATION OF THE ELEMENTS COMPOSING A MASS

Filed August 15, 1923. 5 Sheets-Sheet 1

Fig. 1.

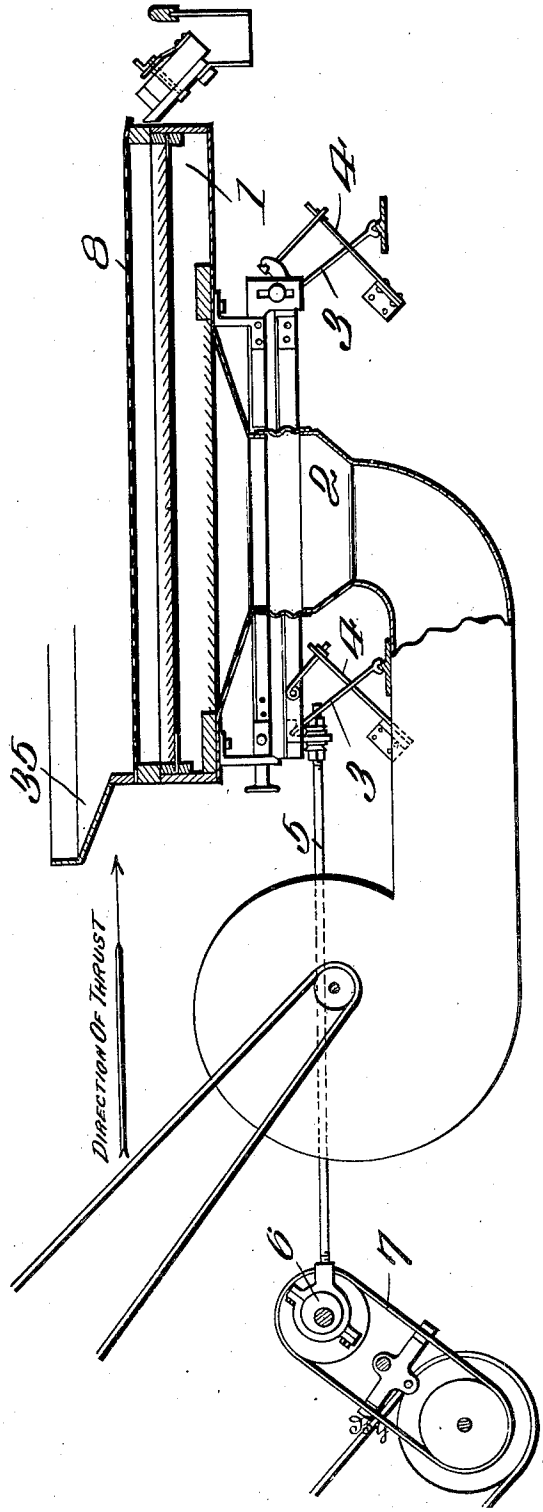
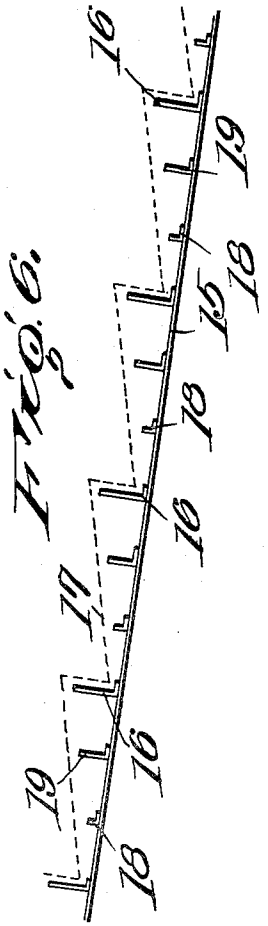


Fig. 6.



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PROCESS AND APPARATUS FOR DRY SEPARATION OF THE ELEMENTS COMPOSING A MASS

Filed August 15, 1923 5 Sheets-Sheet 2

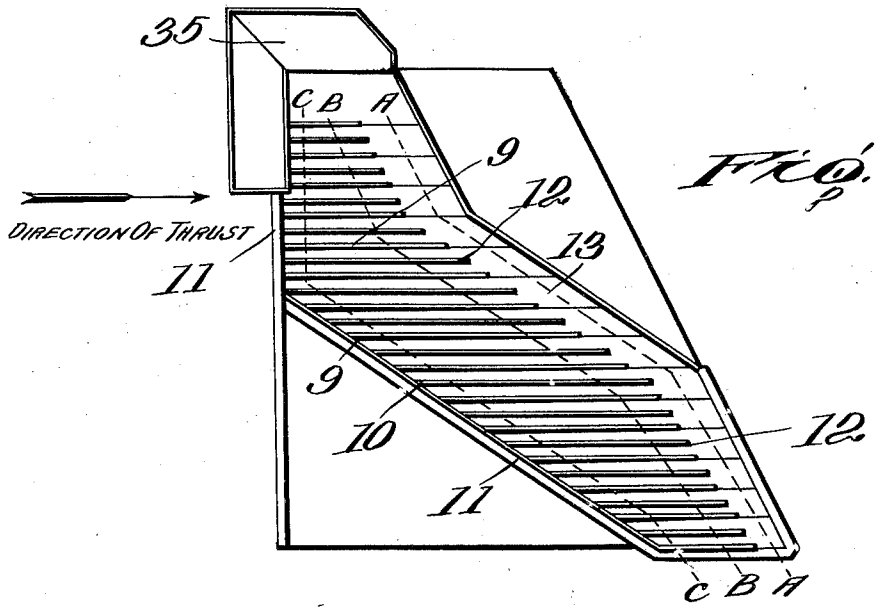


FIG. 2.

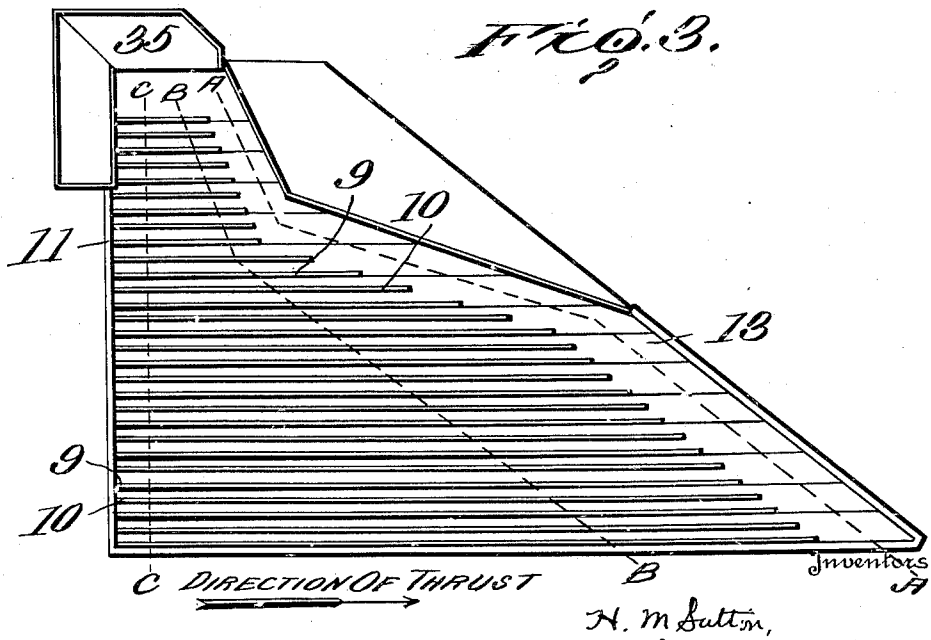


FIG. 3.

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PROCESS AND APPARATUS FOR DRY SEPARATION OF THE ELEMENTS COMPOSING A MASS

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Fig. 5.

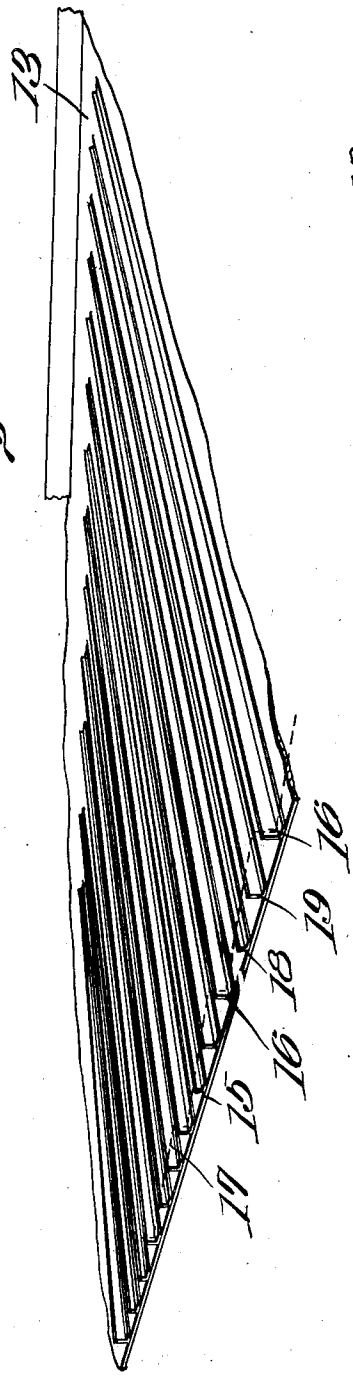
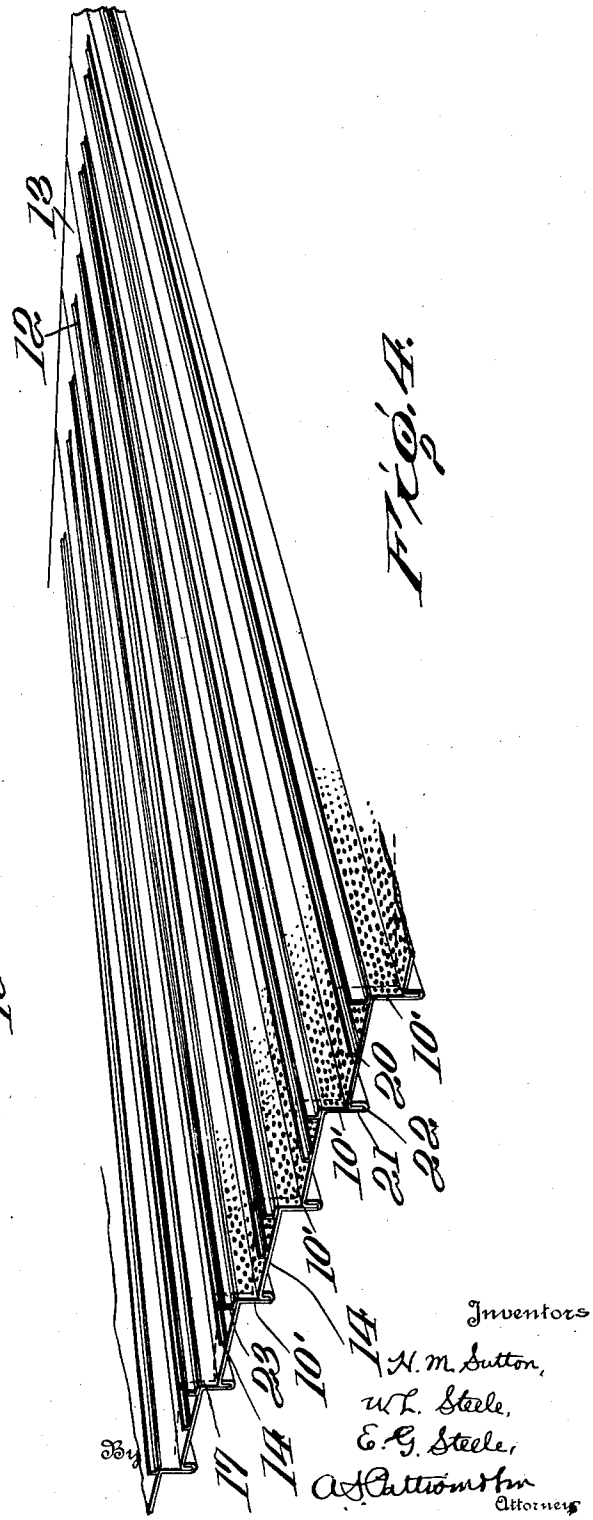


Fig. 4.



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PROCESS AND APPARATUS FOR DRY SEPARATION OF THE ELEMENTS COMPOSING A MASS

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Fig. 7.

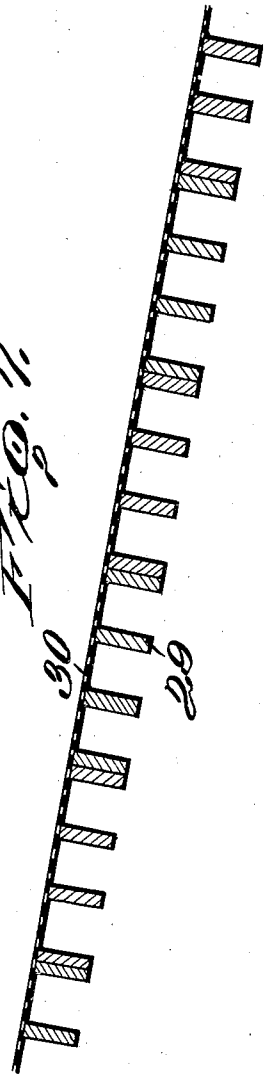


Fig. 8.

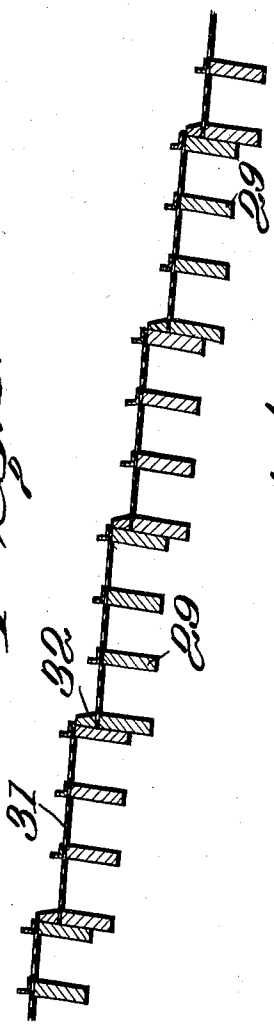
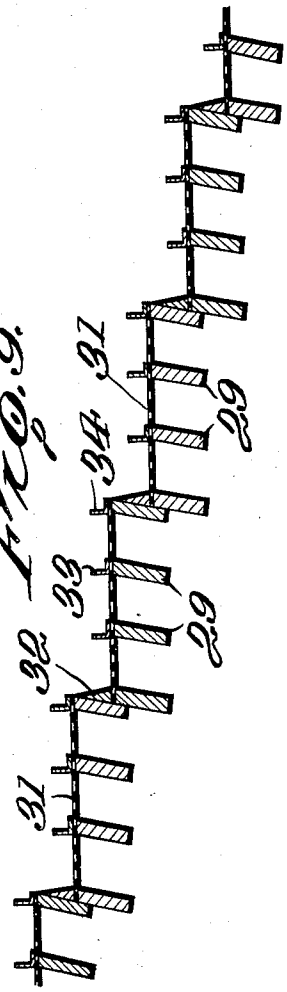


Fig. 9.



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PROCESS AND APPARATUS FOR DRY SEPARATION OF THE ELEMENTS COMPOSING A MASS

Filed August 15, 1923 5 Sheets-Sheet 5

Fig. 10.

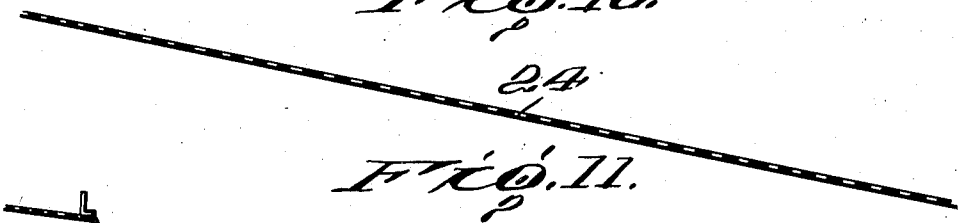


Fig. 11.

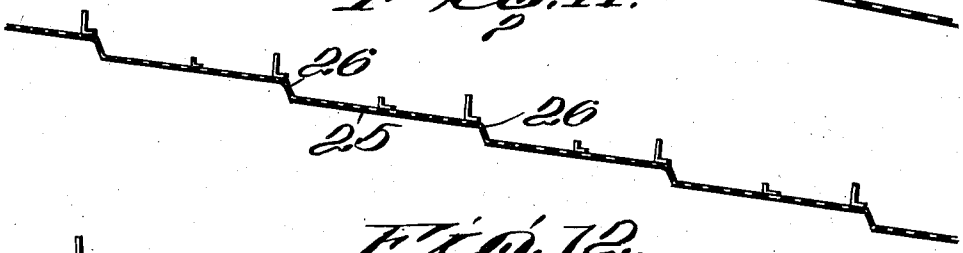


Fig. 12.

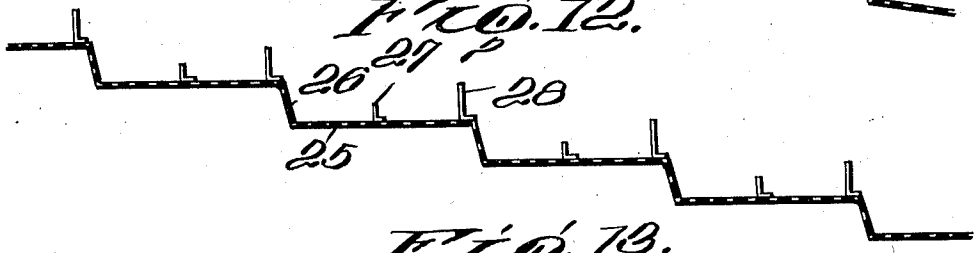


Fig. 13.

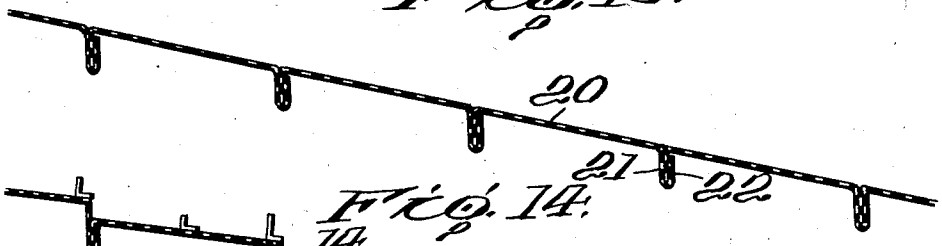


Fig. 14.

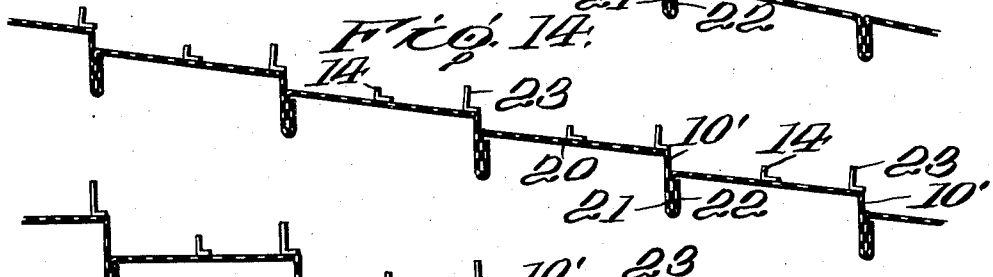
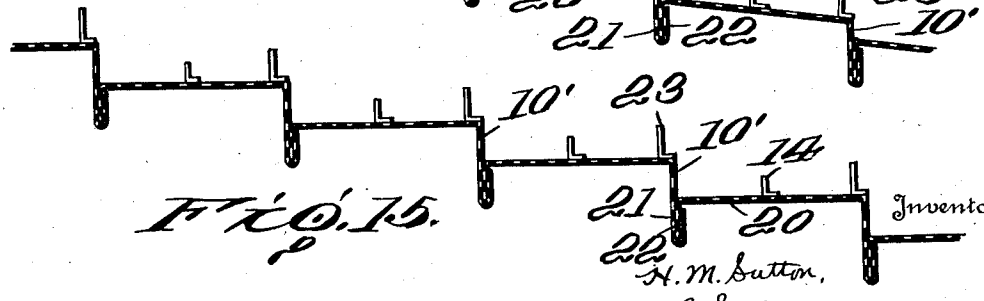


Fig. 15.



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UNITED STATES PATENT OFFICE.

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PROCESS AND APPARATUS FOR DRY SEPARATION OF THE ELEMENTS COMPOSING A MASS.

Application filed August 15, 1923. Serial No. 657,566.

This invention relates to the process and apparatus for dry separation of the elements composing a mass, and it pertains to certain improvements in the process, and in the formation of the separating deck for carrying out the process.

This invention is an improvement upon our prior patents and pending applications, which are exemplified, for instance, in Patents Nos. 797,293 dated August 15th, 1905; 898,020 dated September 8th, 1908; 979,046 dated December 20th, 1910; 1,073,644 dated September 23rd, 1913; 1,133,760 dated March 30th, 1915; and 1,315,881 dated September 9th, 1919.

In all of the foregoing patents, we utilized a reciprocating table having a thrust action in a direction towards the delivery end of the table. In these patents the inclinations of the said table is adjustable to suit the various kinds of material acted on, and the speed of reciprocation is also adjustable through a suitable speed change gearing. Also in these patents an air chamber is located under the table and air is fed through the separating deck and acts upon the mass of material being separated. All of the foregoing features are preferably used in the present invention.

The process practiced by the foregoing patents, crudely stated, is by the combined effect of the air-cushion, the longitudinal thrust, and the action of gravity throughout the whole table.

Our present improvement while capable of separating, cleaning, etc. the elements composing a mass of different kinds of material, is especially intended for the use in the separation and cleaning masses of coal.

The primary object of our improved process is to wholly or substantially prevent the lateral movement of the heavier elements of the material by gravity at the feed end of the deck, and gradually increase the lateral movement by gravity until the delivery end of the table of the deck is reached, where the full effect of lateral movement by gravity is obtained. This process differs from our patents, which provide for a uniform lateral movement of the material by gravity throughout the deck.

Another object of the invention is to so construct the table that the material being separated passes over it in step formation, which is found to have the special advantages in the separation of the elements composing a mass of coal products.

A further object of the invention is to form the surface of the deck into longitudinally extending step formation, whereby the particles composing the mass, and more particularly the heavier elements, fall from one step to another in their passage along the deck, depending upon their relative heavier specific gravity or shape.

Another object of the invention is to form the floor of the separating deck into longitudinally extending step formation, the steps gradually decreasing in depth from the feeding side or end to the delivery side or end of the deck. This construction is effective in stopping or substantially stopping the flow of the heavier particles of the mass by gravity at the feed side of the table, and to gradually remove the stopping effect and gradually permit the lateral gravity feed of the elements until the delivery side of the table is reached where the obstruction to the gravity feed is entirely removed, and where the gravity action has its full effect.

A further object of the present invention is to perforate the vertical rise of the steps, whereby a cross-blast of air is effected at each step which materially assists in the separation of the particles composing the mass.

Further objects of the invention will appear from the following description.

In the accompanying drawings,

Figure 1 is a longitudinal sectional view of a table embodying our improvement.

Fig. 2 is a top plan view of one form of the separating deck embodying the said improvement.

Fig. 3 is a top plan view of another form of separating deck, embodying the said improvement.

Fig. 4 is a detached perspective view of a portion of the separating deck, the floor being shown in stepped formation.

Fig. 5 is a modified form of the table constructed to have the step action.

Fig. 6 is a cross-section through the separating deck shown in Fig. 5.

Fig. 7 is a cross sectional view through the deck, on the line A—A of Figs. 2 and 3.

Fig. 8 is a cross sectional view through the deck, on the line B—B of Figs. 2 and 3.

Fig. 9 is a cross-sectional view of the deck on the line C—C of Figs. 2 and 3.

Fig. 10 shows a cross-sectional view of a modified form of deck on the line A—A of Figs. 2 and 3.

Fig. 11 is a cross-sectional view of a modified form of the table on the line B—B of Figs. 2 and 3.

Fig. 12 is a cross-sectional view of a modified form of the deck on the line C—C of Figs. 2 and 3.

Figs. 13, 14 and 15 are cross-sectional views of a sectional deck, the views being taken respectively on lines A, B and C of Figs. 2 and 3.

Referring now to the drawings, in carrying out our present improvement, we have a deck frame or formation 1, to the lower side of which is connected an air-passage 2, which has its opposite end provided with means for feeding air to the deck. The deck is suitably supported upon rockers 3, and is provided with suitable springs 4. The deck is reciprocated by means of a rod 5, operatively connected with an eccentric 6, which is driven by a suitable speed change device 7. All of the foregoing parts will be of the constructions set forth in our aforesaid patents and need not be further described.

Our present improvement is in the process, and the formation of the deck 8. Our present improvement may be applied to a separating deck of any form or shape and we have shown two shapes in Figs. 2 and 3, but desire it to be understood that other shapes of separating deck may be used without departing from the spirit and scope of our present invention.

Our present improvement is in so constructing the deck of the pneumatic table in a shape which will provide a series of steps, which extend longitudinally of the deck and are arranged in succession across the deck.

By referring to Figs. 2 and 3, it will be noted that the table reciprocates lengthwise of the steps 9, and that narrow riffles 10 are located between the steps. The deck is preferably composed of a perforated sheet. It is desired that it be understood, however, that it may be provided with the refinements specified in our said patents and still involve our improvement. As here shown, however, for simplicity it consists only of a perforated sheet.

We have herein shown several formations, but in each of them we provide the step action, whereby our improvement is carried out.

For the purpose of explaining the invention, we will refer to Fig. 4, wherein is shown the gradually reduced height of the step, though Fig. 4 shows the deck in sections, which is a special form.

By reference to this figure it will be observed that the deck is composed of a series of steps and that these steps succeed each other transverse the table or deck. Attention is directed to the fact that at the feed end 11 of the deck, the steps are made deepest and that they gradually decrease in height from the end 11 and disappear at 12, which is the delivery side 13 of the deck. It will thus be observed that these steps being deepest at the delivery side of the table, gradually decrease in height until they merge into the plane portion 13, at the delivery side of the deck. Located between the step portions 10′ are shallow riffles 14, the said riffles acting as do the riffles in our said patents. The gradual decrease of the height of the steps, irrespective of whether the deck be made in one or the other form, is illustrated for one form of the deck in Figs. 7, 8 and 9; another form in Figs. 10, 11 and 12, and in another form in Figs. 13, 14 and 15, the said figures being taken through the deck on the lines A, B and C of Figs. 2 and 3, irrespective of the manner of forming the step construction. The construction of deck shown in Figs. 2 and 3 is the sectional formation shown in Figs. 13, 14 and 15.

In Figs. 5 and 6, the form of deck consists of the perforated plate 15, which is placed at an inclination and the deck is provided with the step portions 16, the step action being shown by dotted line 17. It will thus be observed that instead of having the steps formed directly in the deck, they are formed by projections 16, which gradually reduce in height from the feed to the delivery side of the separating deck. By reference to Fig. 6, the step formation is clearly illustrated by the dotted line 17. In this construction, there is provided two riffles 18 and 19 between the steps 16. Whether the steps be formed in the manner shown in Figs. 5 and 6, or in the manner shown in the other figures of the drawings, the operation will be substantially the same. In the construction shown in Fig. 4, the floor 20 and the riser 10′ are made of a single piece, the rear portion 21 of the body of the step interlocking with a U-shaped bend 22, formed on the bottom of the riser 10′ of the step. In this construction, the riser 10′ is provided with perforations as well as the body portion 20, whereby air from the air-chamber is forced upward through the perforations of the body 20 and are forced horizontally forward through the riser portion 10′, across the said deck, the function of which will be referred to hereinafter. In this step formation the height of the riser portion 10′ is increased by a riffle 23 extending vertically substantially above the riser 10′. In this case it will be observed that the riser portion 10′ is perforated, and the riffle 23 is imperforate.

In Figs. 10 and 12, inclusive, we show another form of deck for carrying out our invention. In this instance, we form the deck of a perforated plate 24, which has formed in it the steps 25, and the steps are made deepest at the feed end of the deck and disappear at the delivery end of the deck. In this case, the perforated metal has the risers 26 also perforated, and is provided with the intermediate riffles 27, and with the riffles 28 in substantially a line with the risers of the steps.

All of these constructions operate to substantially destroy the lateral movement by gravity at the feed side of the deck, while the lateral gravity movement has full action at the delivery side of the deck, and the gravity action increasing from the feed side to the delivery side of the deck.

In the construction shown, the riffles 23, which are located in substantially a line with the riser 10', serve to stop the gravity flow transverse the table at the feed side, and these riffles gradually decrease in height until they disappear just before reaching the delivery side of the deck.

Immediately at the feed end the gravity flow is positively stopped, but the gravity flow will gradually increase towards the delivery end of the deck.

In Figs. 7, 8, and 9, the deck is supported upon suitable ribs 29 that extend lengthwise of the table. At the delivery side 30 (Fig. 7) the deck is in a smooth plane, but from that point towards the feed side of the table, it is formed in steplike shape, the floors 31 of the steps being perforated as shown. In this construction, the risers 32 are not perforated, and in that event the feature of the cross-blast of air is omitted. The floor 31, however, is provided with riffles 33 and 34, which act in this construction as described in the other constructions.

In operation, the material to be separated is fed into the feed hopper 35 and it immediately flows by gravity to the deck surface, where it is acted upon in the preferred form by three forces, as follows: 1st, an ascending air-pressure; 2nd, a positive thrust in a direction away from the feed side lengthwise of the deck, and 3rd, a movement by gravity crosswise of the deck. As the deck is agitated, this gravity movement is zero to the elements which are upon or immediately above the deck surface, and of considerable force to the elements which are raised above the tops of the riffles by the ascending air. There is no gravity feed of the elements at the feed side of the deck. Each step of the deck surface will, therefore, interrupt the lateral movement of the heavier elements which seep through the mass of material on the deck surface, but will not interrupt the lateral movement of the lighter elements forming the upper strata of the material being handled. The heavier elements will, therefore, be projected away from the feed by the agitation of the deck lengthwise of the deck, while the lighter elements are moving cross-wise of the deck, the foregoing action being rapid at each of the steps until the heavier elements are effectively separated from the lighter elements, at which time the lighter elements may reach the floor of the steps when they will be propelled lengthwise of the deck until they reach a point on its decreased step surface where the decreased height of the riffle and the increased angle of inclination forces them to take up their proper lateral movement. In the operation of the deck, in handling particles of large size, the deck construction shown in Figs. 10 to 11, and 13 to 14, will be used, the construction of which provides the additional cross-blast of air through the risers. This lateral movement of the air facilitates the lateral travel of the lighter elements and the regulation will be such as to trap a particle of the heavier elements in order to force it forward to the discharge end of the deck, while the cross-blast of air, together with the crowding action of the multiplicity of particles will move the lighter elements cross-wise of the deck.

In the operation of a machine embodying the improvements, particularly in cleaning coal, which may carry thin slivers of refuse material, the flat pieces of bone or slate, although having a greater specific gravity than coal, float on the upper surface of the coal-bed, because of their shape, as they ride on the air above the coal and pass off the deck with the coal product. This new deck of the step construction destroys this continuous movement of the slivers by gravity at the feed end of the deck, thus preventing the continuous lateral movement of such flat particles and cause them to tip edge-wise of the ascending air at each step. This action allows the heavier elements to bed themselves below the lighter coal elements, and thus be propelled length-wise to their proper discharge point at the discharge side of the deck. The foregoing is one of the many advantages in operation of our improved deck construction.

As our decks are preferably constructed of perforated metal, the risers of the steps are pervious to air, which gives a cross-blast at each step, flowing cross-wise the deck in a direction towards the lower discharge side, and as these steps gradually decrease in height towards the discharge end of the deck, a strong air-blast is provided at the feed end of the deck, which gradually diminishes to nothing at the discharge end of the deck. When it is borne in mind that the table declines from the feed end, the step construction provides a series of flat

surfaces at the feed end, which gradually merge into an inclined surface at the discharge end, plus a lateral air-blast which has its full force at the feed end and diminishing to nothing at the discharge end.

The table will be adjusted to an angle which makes the steps substantially horizontal, while they decrease in height and disappear entirely at the delivery end of the table where there is an inclined surface without steps. Of course, it will be understood that the angle of a table will vary, according to the characteristics of the material being handled.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. An improved process for separating the elements of a mass, which consists in subjecting said mass to a plurality of successive horizontal step by step separations and simultaneously reciprocating the mass in a direction longitudinal the said step separation.

2. The process of separating the elements of a mass which consists in floating the said mass upon successive horizontal separated air cushions arranged in successive step by step formation and simultaneously reciprocating the said mass in a direction longitudinal the length of the step by step formation.

3. The process of separating the elements of a mass, which consists in floating the mass upon an upwardly acting substantially continuous air-cushion, obstructing the gravity flow of the elements at the point of feeding, subjecting the said mass to a cross-current of air at the feeding point, and removing the obstruction and the cross-current of air at the delivery point.

4. The process of separating the elements of a mass, which consists in floating said mass upon horizontal separated step by step air cushions and gradually merging said separated step by step separation into a substantially flat separation at the discharge of said elements.

5. An improved reciprocating deck for dry separators, comprising means for reciprocating the deck, the deck having a pervious floor forming a continuous air cushion and provided with step-like members extending longitudinal the direction of the reciprocation of the deck, to operate as described.

6. An improved deck for dry separators having a pervious floor forming a continuous air cushion, the said deck having longitudinally arranged step-like members which are deepest at their feed end of the machine and disappear at the delivery end of the machine.

7. An improved separating deck for dry separators having a pervious floor forming a continuous air cushion, the deck comprising a step-like formation at the feed end, the said steps disappearing at the beginning of the delivery end of the deck.

8. An improved deck for dry separators having a pervious floor forming a continuous air cushion, the deck having step-like arrangements which extend longitudinally of the deck, the said steps being deeper at the feed end and gradually decreasing in height to the delivery end.

9. An improved separating deck for dry separators having a pervious floor forming a continuous air cushion, comprising a deck having a plurality of horizontal surfaces at its feed end, said surfaces disappearing into an inclined delivery end.

10. An improved deck for dry separators having a pervious floor forming a continuous air cushion, the deck comprising a plurality of longitudinal steps which gradually decrease in height from the feed end to the beginning of the delivery end, for the purpose described.

11. An improved reciprocating deck for dry separators having a pervious floor forming a continuous air-cushion, the deck comprising a plurality of longitudinally extending steps, said steps having longitudinally extending riffles, said steps and riffles extending in a line with the reciprocation of the deck, for the purpose described.

12. An improved reciprocating separating deck for dry separators having a pervious floor forming a continuous air cushion, the deck comprising a plurality of longitudinaly extending steps, the said steps consisting of perforated metal, and the riffles mounted upon the metal, said steps and riffles extending in a direction longitudinal the reciprocation, for the purpose described.

13. An improved deck for dry separators having a pervious floor forming a continuous air cushion, the said deck comprising a plurality of longitudinally extending pervious steps connected by pervious risers whereby the air acts for the purpose described.

14. An improved deck for dry separators having a pervious floor forming a continuous air cushion, comprising a perforated sheet shaped into a plurality of longitudinally extending steps, the said steps decreasing in height from the feeding end to the delivery end, the delivery end being inclined.

15. A separating deck for dry separators having a pervious floor forming a continuous air cushion, a deck comprising a plurality of step-like formations beginning at the feed end and disappearing at the delivery end, said steps having vertically extending riffles located at their edges.

16. An improved deck for dry separators having a pervious floor forming a continu-

ous air cushion, the deck comprising a plurality of step-shaped formations, the said steps being deepest at the feed end and disappearing at the delivery end of the deck, vertically extending riffles located substantially at the front edges of the steps, and riffles located between the front and rear edges of the steps.

17. An improved deck for dry separators having a pervious floor forming a continuous air cushion, the deck composed of a plurality of steps, each step consisting of an L-shaped step having its edges interlocking with the edges of the adjacent step.

In testimony whereof we hereunto affix our signatures.

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EDWIN GOODWIN STEELE.