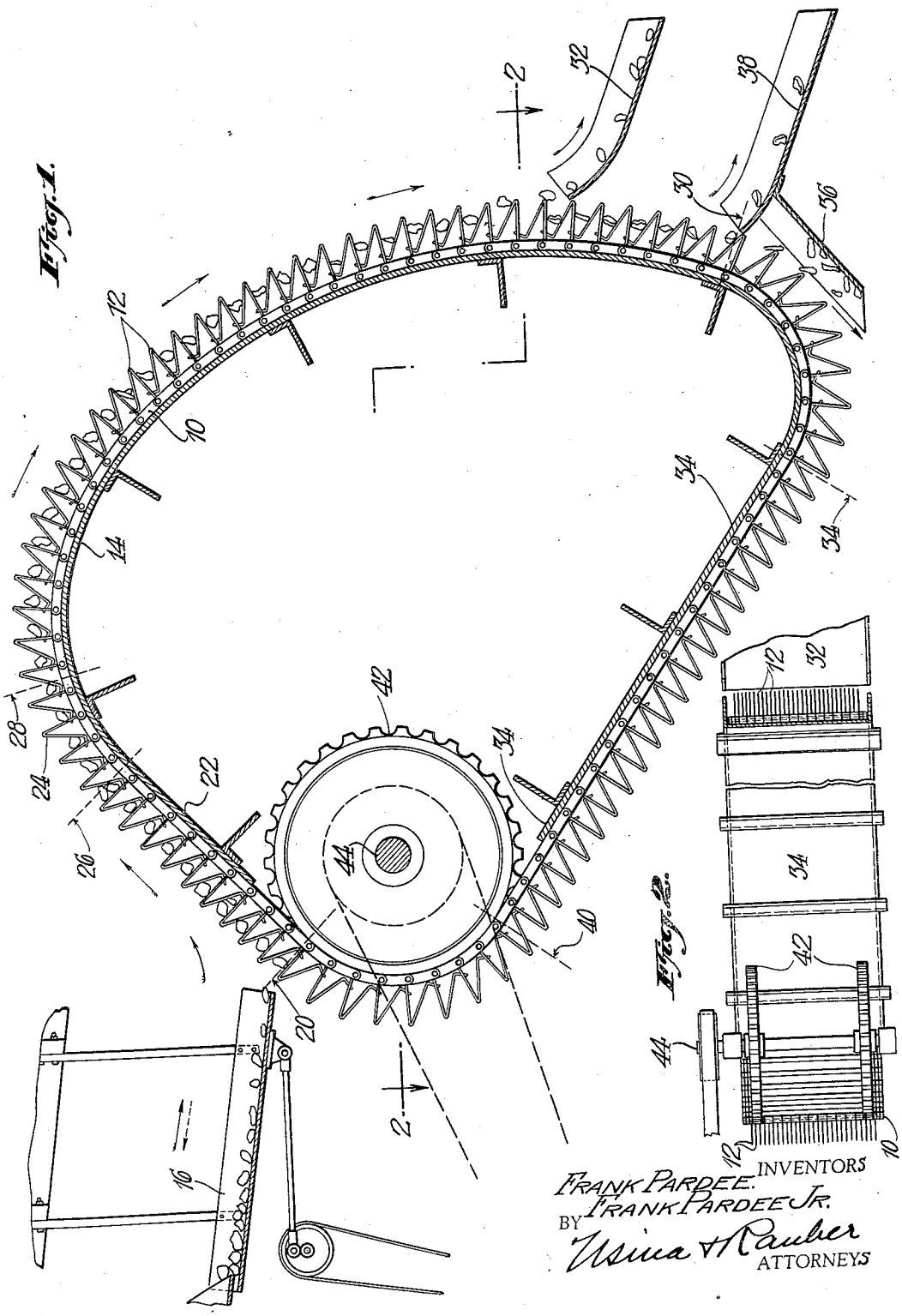
Aug. 31, 1937. F. PARDEE ET AL 2,091,564

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Filed Nov. 2, 1935 3 Sheets-Sheet 1



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Fig. 3.

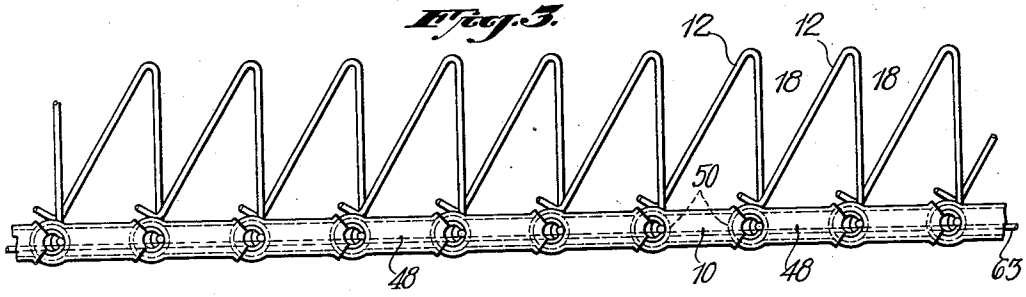


Fig. 4.

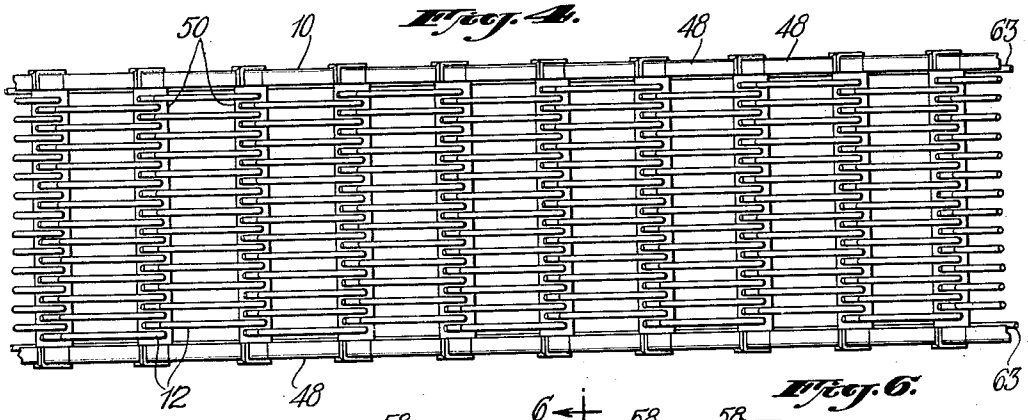


Fig. 5.

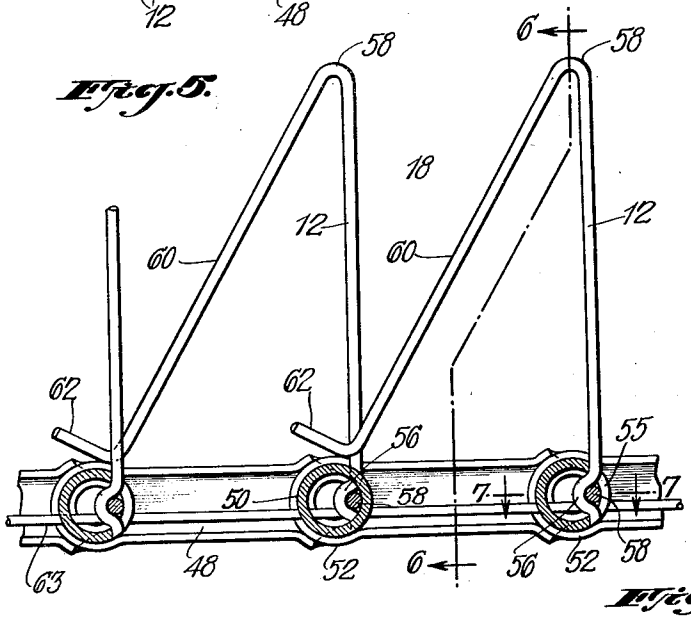


Fig. 6.

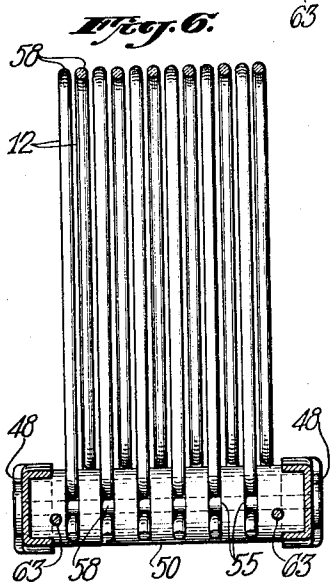


Fig. 7.

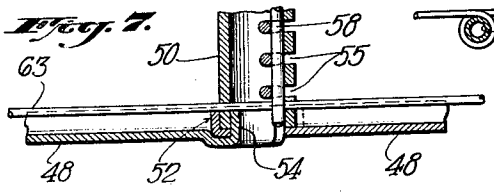


Fig. 15.



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Fig. 8.

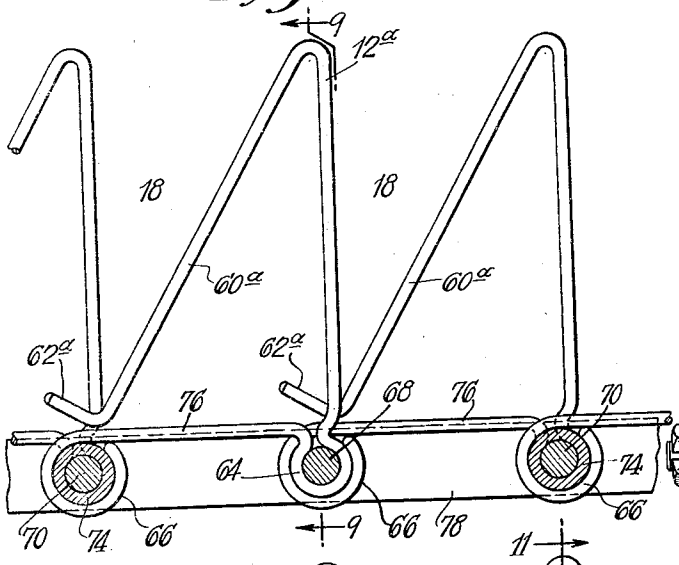


Fig. 9.

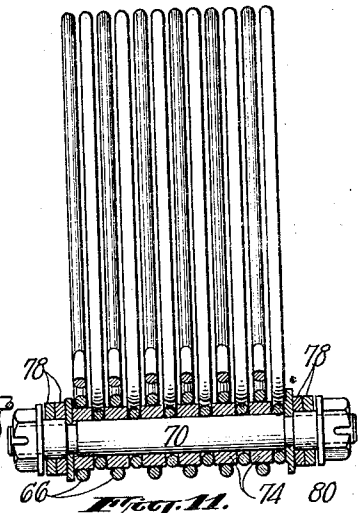


Fig. 10.

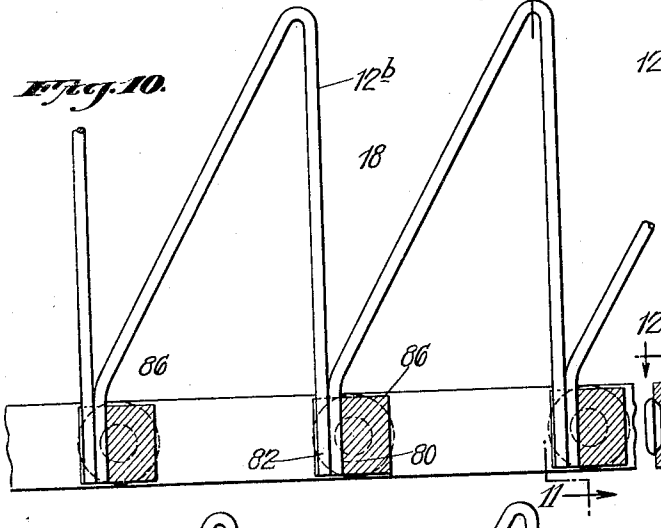


Fig. 11.

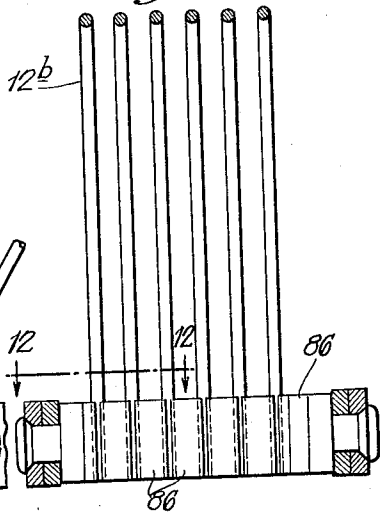


Fig. 12.

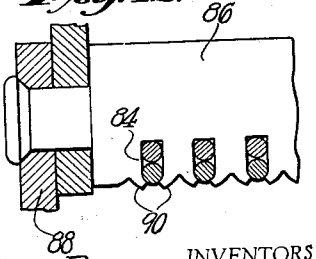


Fig. 13.

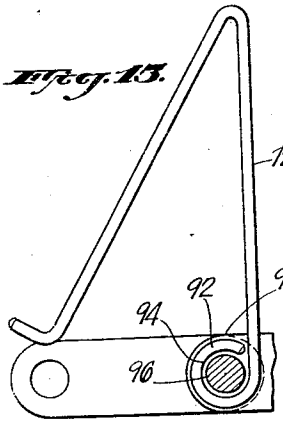
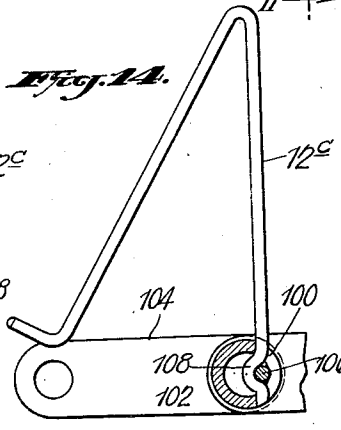


Fig. 14.



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Patented Aug. 31, 1937

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UNITED STATES PATENT OFFICE

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SEPARATOR

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Application November 2, 1935, Serial No. 47,928

18 Claims. (Cl. 209—108)

This invention relates to improvements in separators adapted to handle lump materials of differing frictional characteristics. While not limited thereto, it is well suited for separating lumps of coal from slate or other refuse such as ashes, ore and other impurities which frequently become mixed with good coal.

Coal is a relatively hard carbonaceous material having a bright surface and characterized by a low coefficient of friction. Slate and other impurities such as are frequently mixed with coal is dull and has a materially higher coefficient of friction than coal. Our improved separator takes advantage of the relative difference in frictional characteristics, between the materials to be separated.

The improved separator involves the use of a multiplicity of relatively movable connected jaws which define angular lump receiving pockets and means for causing the jaws to close in on the lumps in such a way as to grip the high friction material and leave free the lumps of low friction material. The jaws are preferably supported on a flexible member and means are provided to bring about a relative motion between adjacent coacting jaws. And, as the flexible member travels, it is arranged to discharge the different classes of material at suitable discharge points.

In the separator of the present invention, the jaws are preferably supported on a chain or equivalent element, the latter being guided over a suitable support having portions at spaced points of different curvature, so as to bring about the required movement between the jaws at different points.

In the separator illustrated, the jaws are in the form of flexible substantially V-shaped members carried by transverse elements supported on the chain and there are a multiplicity of such flexible members disposed transversely of the chain. This permits an arrangement in which the individual jaw elements in a given transverse zone can be flexed various distances, so as to compensate for irregularities in the shapes of the lump material handled.

The above and other features of the invention will be fully apparent from the following detailed description when read in connection with the accompanying drawings and will be defined with particularity in the appended claims.

In the drawings—

Fig. 1 is a view partly in elevation and partly in section of one embodiment of the invention; Fig. 2 is a section on line 2—2 thereof; Fig. 3 is a side elevation illustrating the chain carrying one suitable from the jaw element; Fig. 4 is a plan view of Fig. 3; Fig. 5 is an enlarged section through the chain illustrating the type of jaw element shown in Figs. 3 and 4; Fig. 6 is a section on staggered line 6—6 of Fig. 5; Fig. 7 is a detail horizontal section on line 7—7 of Fig. 6; Fig. 8 is a detail view illustrating an alternative form of flexible jaw element; Fig. 9 is a section on line 9—9 of Fig. 8; Fig. 10 is a sectional detail illustrating a further modified form of the flexible jaw and its supporting element; Fig. 11 is a staggered section on line 11—11 of Fig. 10; Fig. 12 is a detail horizontal section on line 12—12 of Fig. 10; Figs. 13 and 14 are views illustrating further modifications of the flexible jaws; Fig. 15 is a detail view of modified means for maintaining a spring action adapted to normally close the jaws to a minimum predetermined angle.

Referring in detail to the drawings, 10 represents a chain or suitable flexible carrier element which is adapted to support a multiplicity of jaw members, indicated generally at 12. The chain or other flexible supporting element for the jaws is adapted to travel along a guide, indicated generally at 14.

The mixture of lump material to be separated is fed from a shaking chute 16 into the substantially V-shaped pockets 18, which are formed by the adjacent portions of the jaw members 12.

The shaking chute is preferably corrugated longitudinally so that the lumps are lined up more or less in single file. Thus, the corrugations maintain a substantially definite lateral spacing of the lumps so that there is little or no choice of one lump interfering with another.

As the chute 16 is vibrated, the lumps fall into the pockets 18 and as the jaws travel, for example, approximately from the feed point 20 on the guide along the flat portion 22 thereof, the pockets 18, which are of substantially triangular form, are opened to what we should term an intermediate position. As the chain travels over the curved portion 24, the angularity of the pockets 18 will change slightly. This is due to the curvature of the guide 14 between the points 26 and 28. This curvature is relatively sharp and the opening of the pockets permits the lumps previously deposited to find slightly lower seating points. From the point 28 to about the point 30 on the guide, the latter is gently curved relatively much more bluntly. The curve shown is an involute, although other contours will serve, so long as the arrangement is such that there is a gradual closing of the jaws, that is a movement which

tends to decrease the included angle of the pockets 18.

The gradual closing action of the jaws is effective to cause the jaws to grip lumps of relatively high coefficient of friction, such as slate, or other refuse material. But, coal being lighter and harder and of less coefficient of friction will not be gripped, but will slide relatively to those portions of the jaws defined by the pockets 18. Thus, when the jaws reach the point in the zone of the discharge chute 30, the coal being left free will be collected at this point, the chute 32 being adapted to deliver the coal to a suitable storage bin, not shown.

From the point 30 to the point 34, the guide is curved sharply as shown. This will be effective to increase the angle of the V-shaped pockets 18, thus releasing the grip, on the slate or other refuse material of high frictional characteristics, and this material will be discharged by way of discharge chute 36 to a suitable receptacle or dump. In some cases, we will provide a chute 38, which is adapted to receive and direct to a suitable storage place the intermediate product released by the jaws between the chutes 32 and 38. That portion of the guide, which extends from the point 34 to the point 40, is practically a straight run and is substantially tangent with the circumference of a sprocket wheel 42 carried by shaft 44 driven by a belt 46 from a suitable prime mover, not shown.

The chain or other carrier element for the jaws may be constructed in various ways and the jaws themselves may be of different forms. Generally, the chain will have transverse elements, such as pins, tubes, bars or the like. These transverse elements will support jaws having portions extending outwardly from the chain and bent to an angle, said members also having inner portions supported by the transverse elements. These jaw members may be said to be of substantially inverted V-shape and the adjacent members will define the angular lump-receiving pockets 18, whose angularity changes as the chain is flexed in traveling around the guide member, whose different portions are curved or otherwise formed to bring about the required changes in angularity at predetermined points along the line of travel of the chain. For example, in the chain shown in Figs. 3 to 7 inclusive, we provide parallel sets of chain links 48, which support the transversely extending jaw supporting elements 50. These elements in the embodiment of the invention illustrated in these figures are in the form of short lengths of tubing, which engage hub portions 52 formed at one extremity of each link. The opposite extremity of each link has an inwardly extended journal portion 54 which makes a working fit with the inner bore of the tubular element 50. A multiplicity of slots 55 are formed in the tubular element and one inner extremity 56 of each of the jaw members 12 is bent to provide the notch formation shown in Fig. 5.

Key pins 58 are engaged with the notch portions 56, thus firmly anchoring the jaw members 12 to the transverse elements 50. The outermost ends of the jaws are bent around as at 58, so as to provide the inwardly inclined portion 60 of the jaw member. At its inner extremity, this member is provided with an angular extension 62 which passes through the space between a pair of identical jaw members secured to the next adjacent transverse element of the chain. This relationship will be apparent from Figs. 4 and 6. As thus constructed, it is clear that as the chain is flexed in passing around the differently curved portions of the guide 14, the angularity of the pockets 18 defined by the resilient jaws will be changed so as to discharge the different classes of material at different predetermined points along the line of travel of the chain.

Inasmuch as the inner ends 62 of the jaw members are free or unrestrained and furthermore because of the fact that the jaw elements are formed of spring wire or other resilient material, it will be apparent that, when the jaws are first opened to allow the lumps to move toward the bottom of the pockets 18, and when the jaws are subsequently closed in on the lumps, the several coacting flexible jaw members are permitted to flex independently so as to compensate for irregularities in the contour of the lump. And as there are a great number of these thin flexible jaw elements disposed transversely of the lump, it is apparent that the coacting jaws make their influence felt over a considerable extent of the transverse length of the lump.

We deem it important to fixedly fasten each chain link to one of the transverse elements, such as the tubing 50 and to pivotally fasten the link to the following transverse element. For example, assuming the chain in Figs. 3 and 5 to be moving from left to right, the transverse cross pins or tubular members will be fixedly secured in the rear ends of the links and will be pivotally secured to the front ends of the links. Or, stated in another way, each link is fixedly fastened to one cross pin and pivotally fastened to the cross pin following it.

We deem it important that the flexibly connected jaw members be so arranged that there will be a spring action which has a tendency to close the jaws to their minimum angle. This desirable tendency will be readily apparent by reference to Fig. 10, in which the wire elements, of which the jaw members 12b are formed, act as springs, which tend to maintain the chain links in a straightened out condition. As thus arranged, it will be apparent that any bending of the chain around the curved track or guide has a tendency to distort the jaws and their natural tendency is to return to the neutral or unstrained position as in Fig. 10. This desirable spring action is secured with the type of chain shown in Figs. 3 to 7 inclusive by running one or more pieces of straight spring wire 63 through the transverse elements 50. Or, alternatively, instead of having the spring wire 63 pierce the transverse elements 50 the desirable spring action may be secured by arranging the spring wire, as indicated in Fig. 15, wherein loops 65 are formed in the spring wire, which encircle the transverse elements 50 of the chain.

Instead of supporting each flexible jaw from a single transverse pin or supporting element of the chain, we may, as shown in Figs. 8 and 9, provide a construction in which each jaw is jointly supported by two adjacent transverse elements. In these figures, the jaw designated 12a includes a portion 60a having an extension 62a quite like the similarly numbered parts shown in Fig. 5. However, in this construction, the jaw is provided with looped parts 64 and 66 which embrace the transverse elements 68 and 70, respectively. The transverse elements in this construction are in the form of pins, which at spaced points carry washers 74 around which the loops 64 are fitted. The loops 64 and 66 are joined by a base portion 76. Thus, it is apparent that each jaw 12a is jointly supported by two adjacent transverse elements of the chain. This chain includes suitable

side links 78, as illustrated, having nuts 80 secured to the extremities thereof.

Figs. 10 and 11 illustrate a further modified form of jaw. In this construction, the jaw 12b has its lower extremities 80 and 82 seated in slots 84 formed in the transverse elements 86, which forms the spacers between the links 88. The slots are swaged over, as indicated at 90, so as to prevent dislodgment of the inner extremities of the jaws. In this form of jaw, it will be understood that, as the chain travels around the portions of different curvature, the material of each jaw itself will be flexed, so as to vary the angularity of the V-shaped pockets.

Fig. 13 illustrates a modification in which the jaws 12c are provided at their inner ends with hook portions 92, which engage bushings 94 fitted over the transverse elements 96 carried by the chain links and the adjacent jaws are separated from one another by spacing washers 98.

A further modification is illustrated in Fig. 14, in which the jaws 12c are secured at their inner ends in slots 100 formed in the tubular transverse elements 102, which in turn are secured to the chain links 104. In this construction, a key pin 106 will be inserted to coact with the notched portion 108 formed at the inner extremity of the jaw member

From the foregoing, it will be clear that in the operation of the improved separator, the individual lumps discharged from the shaking chute 16 will be deposited approximately in a row extending transversely of the separator. As the jaws travel along the straight portion of the guide, the lumps will remain substantially unchanged, except for any slight alteration in their position occasioned by the forward travel of the chain. However, as the chain reaches the curved part, the angularity of the pockets 18 will be increased, this first change taking place between the points 26 and 28. This will permit the lumps to settle in the lower parts of the pockets, due to the slight opening of the pockets 18.

Thereupon, as the jaws travel over the long path from the point 28 to the point 30, the angularity of the pockets will be gradually decreasing, thus acting on all of the lumps in a manner to grip the high friction material, such as slate or other refuse and to force outwardly the coal or low friction material. Such action will discharge the coal or low friction material, but will hold within the grip of the jaws the slate or high friction material until the jaws are open sufficiently to discharge it to chute 36, by reason of the fact that at this time the chain passes over the sharply curved portion of the guide track. After said discharge, the cycle is completed by the jaws returning to the sprocket wheel 42 at the starting position, it being apparent that the curvature of this sprocket wheel is approximately tangent to the adjacent straight portions of the chain guide. It is, of course, apparent that the sprocket wheel 42 can be located at points other than that illustrated along the path of travel of the chain. For example, it could, if desired, be placed either in the relatively sharp bend at the top of the curved guide adjacent the points 14 and 28 of Fig. 1 or, alternatively, it could be located in the sharp bend between the points 30 and 34 in the lower part of Fig. 1.

While we have described quite precisely certain specific details of the embodiment herein illustrated it will be understood that the drawings and description are to be interpreted in an illustrative rather than a limiting sense since various modifications may be made by those skilled in the art without departure from the invention as defined in the appended claims.

What we claim is:

1. A separator for lump materials of differing frictional characteristics comprising a multiplicity of relatively movable link connected resilient jaws defining angular lump receiving pockets extending transversely of the direction of travel of said jaws, a guide along which the jaws travel, and respective means at spaced intervals along the guide effective to impart to said jaws in sequence an opening, a closing and an opening movement.

2. A separator for lump materials of differing frictional characteristics comprising a flexible chain having a multiplicity of movable resilient jaws supported thereon, a fixed guide plate over which the jaws travel, said guide plate having spaced portions differing in curvature and effective to impart closing and opening movements to said jaws.

3. A separator for lump materials of differing frictional characteristics comprising a traveling chain having links supporting a multiplicity of V-shaped spring wire jaws secured to members aligned with the connections between adjacent links adapted to be flexed variable distances so as to compensate for irregularities in the shapes of the lumps handled and means for effecting relative movements between the sets of jaws carried by adjacent links at spaced points along the path of travel of the chain.

4. A separator for lump materials of differing frictional characteristics comprising a traveling chain carrying a plurality of sets of V-shaped spring wire jaw elements adapted to be flexed variable distances so as to compensate for irregularities in the shapes of the lumps handled, said elements being supported by members centered with the pintle connections of the links of said chain and respective means located at spaced intervals along the path of travel of the flexible members effective to impart gripping and releasing movements to said sets of jaw members.

5. A separator for lump materials of differing frictional characteristics comprising an endless chain with links carrying sets of V-shaped spring wire jaw elements defining inwardly converging triangular lump-receiving pockets, said elements being supported by members centered with the pintle connections of the links of said chain, a guide track having respective cam portions at spaced intervals therealong effective to impart opening and closing movements in predetermined sequence to adjacent sets of said jaw elements.

6. A separator for lump materials of differing frictional characteristics comprising a traveling chain having links, means aligned with the pivotal connections between the links supporting a multiplicity of V-shaped resilient jaw elements adapted to be flexed variable distances so as to compensate for irregularities in the shapes of the lumps handled, a track over which said chain travels, a plurality of short length-spaced portions thereof being sharply curved to open said jaw elements and another portion of the track being more bluntly curved over a greater length to slowly close said jaw elements.

7. A separator for lump materials of differing frictional characteristics comprising a traveling chain, a multiplicity of sets of relatively movable resilient jaws carried thereby which coact to close in on the lumps to be separated, means for feeding the lumps to the bite of said jaws, means for

slightly opening said jaws to cause the lumps to settle down into the bite thereof, means tending to gradually close said jaws, whereby lumps of high coefficient of friction are gripped by the jaws and lumps of low coefficient of friction are left free, means for catching said freed lumps at a predetermined point along the path of travel of the chain, means for opening said jaws and thereby releasing the high friction lumps and means for catching the high friction lumps, and a driver for said chain, the said jaws being supported by members which are axially aligned with the pivotal connections between the links of said chain.

8. A separator for lump materials of differing frictional characteristics comprising a traveling chain having cross pieces which support flexible jaws which jointly form a multiplicity of lump receiving pockets, means for feeding the lumps to be separated to said pockets, means for initially separating the coacting jaws, means for subsequently effecting a closing movement of the jaws and effective to cause them to grip lumps of high frictional characteristics, such as slate or refuse and to slip relatively to lumps of low frictional characteristics such as coal, means for receiving the latter as the jaws pass a predetermined discharge zone, means for opening the jaws at a point beyond said discharge zone to release the slate or refuse and means for receiving the latter.

9. In a separator for lump material a chain having spaced transverse elements which carry a plurality of flexible V-shaped wire members so arranged that adjacent sets of said members jointly form lump-receiving triangular pockets which converge toward the chain, each of said V-shaped members including one portion firmly secured to one of said tranverse elements and another portion inclined inwardly toward the chain and terminating in the region of the next adjacent transverse element.

10. In a separator for lump material, a chain having spaced transverse elements which carry a plurality of V-shaped bent wire members adjacent ones of which jointly coact to form triangular lump-receiving pockets which converge toward the chain.

11. In a separator for lump material, a chain having spaced cross pins secured to the links thereof and spring wire elements of approximately inverted V-shape supported from the cross pins and jointly coacting and forming triangular lump-receiving pockets.

12. In a separator for lump material, a chain having transverse elements, members having portions extending outwardly from the chain and bent to an angle and inner portions secured directly to said transverse elements, the adjacent members jointly coacting defining angular lump-receiving pockets whose angularity changes as the chain is flexed.

13. In a separator for lump material, a chain having transverse elements, a plurality of wire members having inner portions mounted thereon and having outwardly pointed portions bent to an acute angle, the adjacent members coacting to jointly define angular lump-receiving pockets whose angularity changes as the chain is flexed.

14. In a separator for lump material, a chain having a plurality of links connected by transverse elements, members having portions extending outwardly from the chain and bent to an angle and inner portions secured to said transverse elements, the adjacent members jointly coacting to define angular lump receiving pockets, whose angularity changes as the chain is flexed and means carried by the chain normally tending to maintain the adjacent members in a predetermined relative position.

15. In a separator for lump material, a chain having a number of links carrying spaced transverse elements centered with the link connections and which carry a plurality of bent wire members which jointly coact to form lump-receiving pockets which converge toward the chain and spring means coacting with the chain links and normally tending to maintain said bent wire elements in predetermined relative relationship.

16. In a separator for lump material, a chain with links carrying transverse elements, a plurality of bent wire members each having an inner base portion supported jointly by two of said transverse elements which are adjacent to one another and having an outer portion bent to acute angular form, the adjacent members jointly forming an outwardly opening angular lump-receiving pocket whose angularity changes as the chain is flexed.

17. In a separator for lump materials, a chain with links carrying transverse elements, a plurality of bent wire members each having an inner portion supported jointly by two of said transverse elements and having an outer portion bent to acute angular form the adjacent members jointly forming an outwardly opening angular lump-receiving pocket whose angularity changes as the chain is flexed, means for feeding lump material to said pockets, a guide over which the chain travels having spaced curved portions effective to cause said angularity changes of the lump-receiving pocket at predetermined locations, and means adjacent such locations for receiving different classes of material from said pockets.

18. In a separator for lump material, a chain having parallel sets of links bridged by transverse elements, a plurality of bent wire members of substantially inverted V-shape and whose inner ends have notched portions formed therein, the transverse elements being slotted to receive the notched portions and key pins engaging the latter so as to secure said members to said transverse elements.

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