July 28, 1936. T. M. DODSON 2,048,923

METHOD OF AND APPARATUS FOR SCOURING COAL

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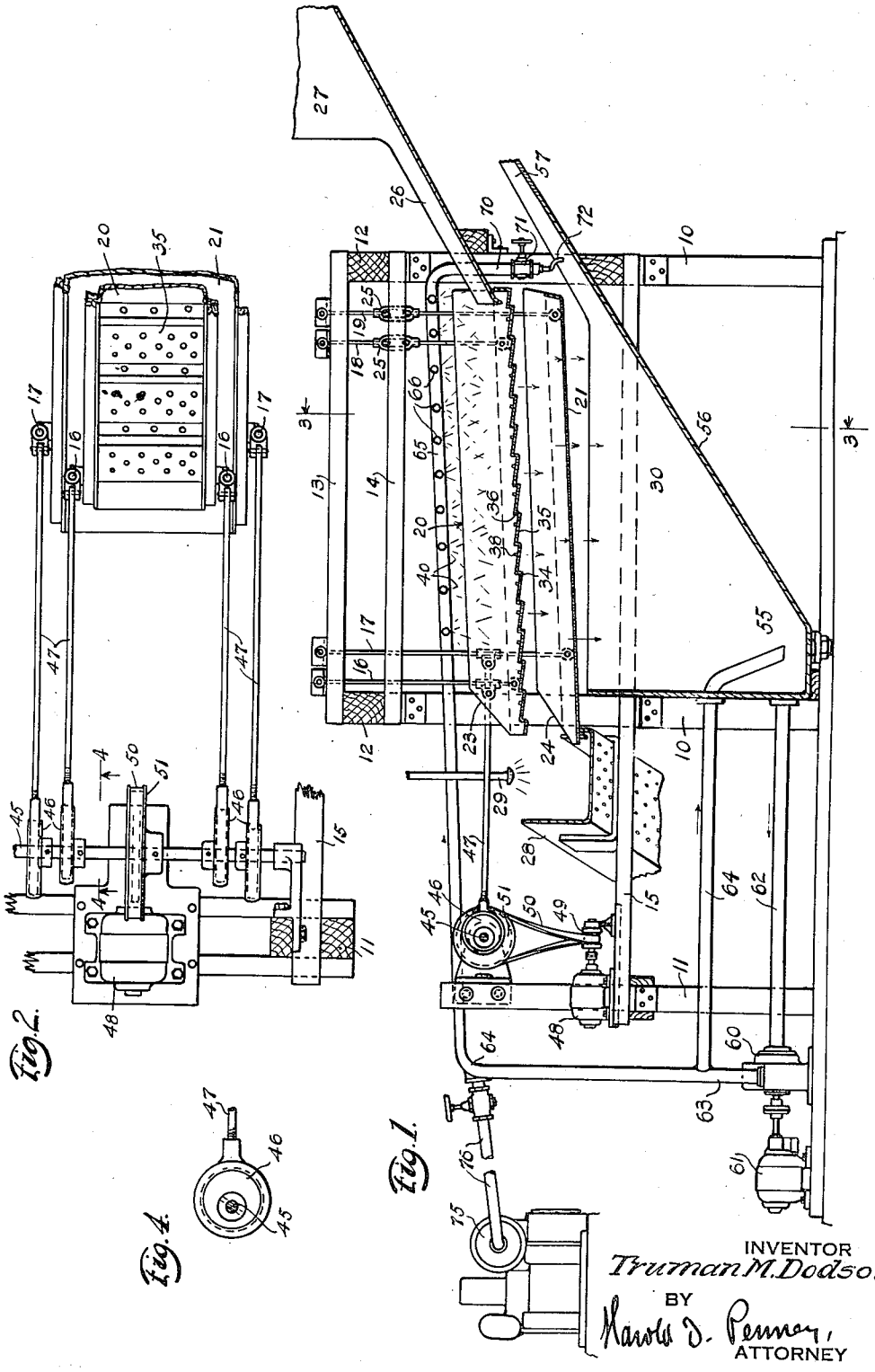


Fig. 2.

Fig. 4.

Fig. 1.

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Fig. 3.

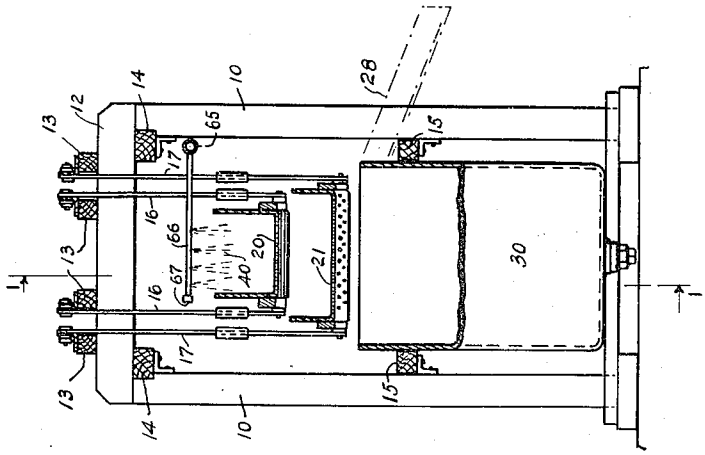


Fig. 6.

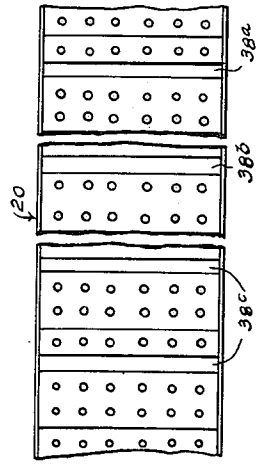


Fig. 5.

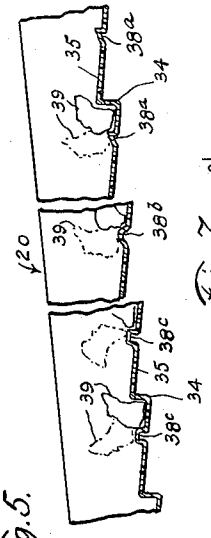


Fig. 7.

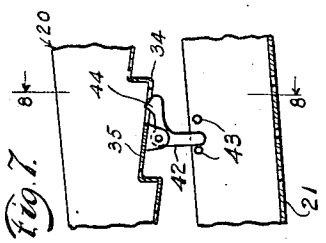
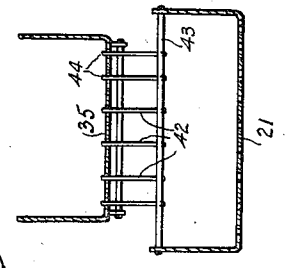


Fig. 8.



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Patented July 28, 1936 2,048,923

UNITED STATES PATENT OFFICE

2,048,923

METHOD OF AND APPARATUS FOR SCOURING COAL

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Application August 9, 1933, Serial No. 684,332

21 Claims. (Cl. 209—2)

This invention relates to scouring methods and apparatus and to means and methods for removing discoloration or stain from coal and polishing coal and more particularly to apparatus and methods for scouring coal by means of a scouring aggregate composed of liquid and fine coal, though it is noted that in some of the claims the invention is not limited to cleaning with fine coal nor even to cleaning coal.

One object of the invention is to provide an improved method and apparatus of this kind by which the coal is cleaned by subjecting the coal to jets of water or fluid mixture mixed with anthracite fines which will pass through a $\frac{3}{16}$ inch round mesh.

Other objects of the invention are to provide an improved method and apparatus of this kind in which the mixture or scouring aggregate may be used over and over in a closed circuit.

Additional objects of the invention are to improve generally the simplicity, capacity and efficiency of such methods and apparatus and to provide an extremely simple method and apparatus of this kind which are economical, rapid and reliable in operation, and economical to install.

Still other objects of the invention will appear as the description proceeds; and while herein details of the invention are described in the specification and some of the claims, the invention is not limited to these, since many and various changes may be made without departing from the scope of the invention as claimed in the broader claims.

The inventive features for the accomplishment of these and other objects are shown herein in connection with a coal scouring or laundering method which briefly stated, includes causing a layer or layers of coal to travel in one or more treatment paths, turning said pieces while in said paths; and subjecting the pieces to action of jets of a scouring aggregate comprising a mixture of water or water and air and fine particles of coal.

This method may be conveniently performed by causing a layer of mixed coal to travel in an inclined upper shaking screen thereby separating the smaller pieces and causing them to drop down and travel in another lower screen, all the time jostling said pieces while in said screens to turn the pieces and present all sides to the action of jets spraying upon the coal of the upper screen with scouring aggregate, thereby causing said mixture to pass through the coal in both screens, to scour and polish the coal, after which the coal from said screens is remixed and washed with clean water while being conveyed off. The aggregate as it passes through said screens is caught and pumped to the nozzles above the upper screen for again spraying it upon the layers of coal.

The invention relates particularly to cleaning stain and rust from anthracite coal by the scouring action of a stream of water or water and air under pressure in which is incorporated a scouring aggregate of anthracite fines. Fines may be defined as coal which will pass through a screen having round openings of $\frac{3}{32}$ of an inch. However, the invention, as claimed in some of the claims, is not limited to this exact size and material.

This scouring aggregate is a product incident to the cleaning of fresh mined coal.

My novel method may be performed in various ways or by means of apparatus shown herein, which apparatus is also a part of the invention.

In the accompanying drawings,

Fig. 1 is a longitudinal vertical sectional view, partly in elevation, showing the apparatus as a whole, the section being taken substantially on the line 1—1 of Fig. 3, looking in the direction of the arrows of said line; Fig. 2 is a plan;

Fig. 3 is a transverse vertical sectional view, partly in elevation, showing the screens in section, the section being taken substantially on the line of 3—3 Fig. 1, looking in the direction of the arrows of said line;

Fig. 4 is a fragmental side elevation of a detail;

Fig. 5 is a fragmental longitudinal vertical sectional view, partly in elevation, showing a modified form of upper screen floor;

Fig. 6 is a plan of the same;

Fig. 7 shows a modified form of means for turning the coal in the upper screen;

Fig. 8 is a section taken substantially on the line of 8—8 Fig. 7, looking in the direction of the arrows of said line.

The various parts of my apparatus for scouring coal and the like are mounted on a frame comprising uprights 10, 11, cross-pieces 12 and longitudinal members 13, 14, 15. Links 16, 17, 18, 19 suspended from the longitudinal members 13 carry a pair of inclined longitudinally shaking screens 20, 21, one above the other and having side walls, low end walls at the receiving-end, and open lower discharge ends 23, 24, and perforated bottoms. Turn buckles 25 in the rear link serve for adjusting the slant of the screens.

A raw material feed chute 26 discharges coal to be scoured from a bin 27 or the like into the receiving end of the upper chute 20. A chute 28

having its upper end under the discharge end 24 of the lower screen serves for receiving, conveying away, and remixing the coal from both screens after it has been scoured, a nozzle 29 discharging a clean water spray over the chute for washing the scoured coal, the bottom of the chute 28 being perforated for drainage.

The lower screen floor 21 (Fig. 3) is wider than that of the upper screen and flat and has perforations therein of preferably about 3/64 to $\frac{3}{16}$ of an inch in diameter to allow passage of the aggregate and smaller pieces into the sump bay 30, while retaining and conveying larger pieces to the trough 28. The upper screen 34 (Fig. 1) is floored with stepped tread perforated plates formed with wide approximately horizontal perforated portions 35 and shallow riser portions 36 therebetween, tending to roll the pieces of coal over when the latter passes the riser portion and moves from one portion 35 to the next. A trip strip 38 is secured on each wide portion 35 spaced, parallel to and after, each riser portion 36 to catch the bottom of the pieces 39 of coal to turn them over as the screen shakes them along to present different sides to the spray 40.

The trip strip 38, may be omitted if desired or may have various shapes as shown at 38*a*, 38*b*, 38*c* of Fig. 5, and may be stamped up from the bottom of the screen.

Instead of a trip strip fast on the screen, I may provide other means. For instance, I may provide small bell-cranks 42 pivoted to the lower face of the upper screen and rocked by pins 43 carried by the lower screen, the upper part of each bell-crank having a nose 44 adapted to move up and down through a hole in the upper screen floor, to agitate and turn the coal in the upper screen.

The upper screen plate has perforations larger than those of the lower screen, to rid the mixed coal of fine pieces, thereby better to expose the large pieces for treatment by the jets of aggregate.

Means for shaking the screens comprises a rotary shaft 45 mounted across the frame beyond the discharge end of the screens and carrying eccentrics 46 receiving the ends of links 47 connected to suspending links 16, 17 of the respective screens, the eccentrics being positioned to move the screens in opposite directions as the shaft is rotated. A variable-speed D. C. motor 48 on said frame has pulley and belt connections 49, 50, 51 with the shaft 45.

The sump bay 30 beneath said screens is wider than the screens and is deepest at 55 under the discharge end of the screens and has a slanting floor 56 slanting upwardly toward the receiving end of the apparatus, and continued to form a feed chute 57 for conveying initial and replenishing charges of make-up aggregate and make-up water into the bay.

A centrifugal suction pump 60 driven by a motor 61 has an inlet pipe 62 for drawing water-and-aggregate mixture from the deepest part 55 of the bay. The pressure pipe 63 is branched to form an agitator pipe 64 discharging into said deepest part to keep the mixture well stirred and mixed. The pressure pipe 63 is continued upwardly and turned, as at 64', over the upper screen to form a spray pipe header 65 provided with lateral branches 66 closed at the outer end 67 and intermediately perforated at the bottom to form a spray nozzle for discharging the jets 40. The pressure for discharging the jets may be slightly more than zero to, say, 125 pounds or more per square inch, for directing sprays of the aggregate mixture downwardly upon the pieces of coal being tumbled on the upper screen, whereby the pieces of aggregate scour and polish the pieces of coal and pass with the water through the perforations of the upper screen 20 upon the fine pieces on the lower screen 21, and then passes to the sump bay and is used again thus forming a closed circuit.

The outer end 70 of the spray head is down turned and provided with a large valve 71 and a removable nozzle 72 for washing out the aggregate feed chute or replenishing make up water. The nozzle 72 may be removed and the valve opened wide for flushing out the header 65.

A motor driven air compressor 75 has a valved outlet pipe 76 extending into the header pipe at the turn 64' and is alined therewith to discharge air at about 100 pounds pressure into the aggregate in the pipe 63 to mix therewith before the sprays are reached.

The operation of the apparatus is obvious from the foregoing. The mixed coal is fed through the chute 26 to the upper screen which causes the coal to be disposed in a thin wide layer of mixed coal to travel in an upper treatment path. The smaller pieces fall through the upper screen to better expose the larger pieces to the action of the jets 40, and the smaller pieces travel in a thin layer in a lower path in the lower screen. The vibration of the screens causes the shaking and turning the pieces of coal while in said paths to expose different sides of the pieces and to separate the scouring aggregate from the pieces which are to be returned to the mixture in the trough 28. The jets 40 continuously spray upon said upper layer, downwardly at a pressure of a little above zero to about 125 pounds or more as found best, the aggregate comprising a sprayable mixture of water or water and air and fine coal, culm or slack or other solid material, preferably such as will pass through mesh openings of 3/64 to $\frac{3}{16}$ inch in diameter, or more or less as found best. The mixture passes through the upper layer and thence through the lower layer and then falls into the sump bay. Coal from both screens discharges, combines and remixes in the chute 28 and is there washed with clean water from the nozzle 29 to remove remains of the scouring aggregate.

The aggregate in the bay 30 is agitated by water from the pipe 64 and is carried through the pump 60 and header pipe 65, to be again sprayed upon the coal in the upper screen, thereby to cause the aggregate to travel in a closed circuit.

My method and apparatus are found to have surprisingly large capacity in tons of coal per hour.

The openings in the bottom of the screen 21 are preferably all of the same size, and may be varied for the purpose intended for the screen 21. The openings in the bottom of the upper screen are all larger; but it is understood that the size of the openings may be varied as desired.

I claim as my invention:

1. A method of scouring coal and removing stain and rust therefrom and restoring the brightness of the coal, said method comprising scouring the coal with a mixture of water and particles of coal larger than dust size and ranging up to particles which will just pass through mesh openings of $\frac{3}{16}$ of an inch in diameter.

2. A method of scouring coal, said method comprising scouring the coal with a liquid and particles of anthracite fines larger than dust size and ranging up to particles which will just pass through mesh openings of $\frac{3}{16}$ of an inch in diameter.

3. A method of scouring lumps of solid material, said method comprising spraying upon the lumps jets consisting of a mixture of water, air and fine particles of anthracite fines which will pass through mesh openings of $\frac{3}{16}$ inch in diameter.

4. A method of scouring coal comprising causing a thin wire layer of mixed coal to travel in an upper treatment path; separating the smaller pieces from the larger and causing the smaller pieces to travel in a thin layer in a lower path; spraying upon said upper layer downwardly directed jets of scouring aggregate; and causing said mixture to pass through said upper layer and thence through said lower layer.

5. A method as in claim 4 comprising discharging and combining and remixing the coal from said paths and washing the mixture with clean water to remove remains of the scouring aggregate.

6. A method of scouring coal for removing stain and rust therefrom and restoring the brightness of the coal, said method comprising causing a thin wide layer of mixed coal to travel in an upper treatment path; separating the smaller pieces from the larger and causing the smaller pieces to travel in a thin layer in a lower treatment path; shaking and turning said pieces while in said path to expose different sides of the pieces; spraying upon said upper layer, at a pressure of from about one to about 125 pounds above atmospheric pressure, downwardly directed jets of scouring aggregate comprising a sprayable mixture of water and air and fine coal or other material which will pass through mesh openings of $\frac{3}{16}$ of an inch in diameter; causing said mixture to pass through said upper layer and thence through said lower layer; discharging, combining and remixing the coal from said paths and washing the mixture with clean water to remove remains of the scouring aggregate; catching the aggregate as it passes through said lower layer; agitating the aggregate; and again spraying it upon the layer in the upper path and again catching it, thereby to cause the aggregate to travel in a closed circuit.

7. In combination, a nonupright screen; a reservoir; a pump drawing aggregate mixture from said reservoir and having its pressure pipe turned to form a spray header directing sprays upon coal of the screen; and an air compressor having an outlet pipe extending into and alined with the header pipe at the turn.

8. In combination, a longitudinally inclined shaking screen; means for discharging coal into the upper end of the screen; a sump bay beneath said screens; and a pump for drawing aggregate mixture from said bay and having its pressure pipe branched to form an agitator pipe discharging into said bay; said pressure pipe being turned to form a spray header directing sprays upon coal of the screen.

9. In combination, a pair of inclined longitudinally shaking screens, one above the other; means for discharging mixed coal into the upper end of the upper screen; a chute for receiving and mixing the coal from both screens; spray means on the chute; the lower screen floor having fine perforations therein; the upper screen being floored with stepped perforated plates formed with wide approximately horizontal perforated portions and shallow riser portions therebetween; the perforations of said portions being larger than the perforations of the lower screen; a trip strip on each wide portion after each riser portion; a sump bay beneath said screens, deepest under the discharge end of the screens; a pump drawing aggregate mixture from said deepest part and having its pressure pipe and branched to form an agitator pipe discharging into said deepest part; said pressure pipe being turned to form a header provided with spray nozzles directing sprays downwardly upon the upper screen; and an air compressor having a valved outlet pipe extending into and alined with the header pipe at the turn, to mix the air with the aggregate.

10. A method of scouring coal comprising causing a thin wide layer of coal to travel in a treatment path; spraying upon said layer with dynamic jets of scouring aggregate comprising a mixture of water and fine particles of coal; said particles being small and few enough for easy spraying, and said jets being continued long enough and being strong and large enough, and said particles large, hard and numerous enough and projected with enough force, to remove stain from the coal, the particles being soft enough to polish the coal and restore the sheen thereto; and turning said pieces while in said paths, thereby to present all sides of the coal to the impact of said particles in the spray, thereby to remove the stain from, and polish, all sides of the coal.

11. A method of scouring coal comprising causing a wide thin layer of coal to travel in a treatment path; spraying, upon said layer, dynamic jets of a scouring aggregate comprising a mixture of water and fine particles; said jets being continued long enough and being forceful enough and said particles being hard and numerous enough to clean the coal, causing said mixture to pass through said layer; catching the aggregate after it passes through said layer; agitating and thoroughly mixing the aggregate, and again spraying forceful jets thereof upon said layer.

12. A method of scouring coal comprising causing a wide thin layer of mixed coal to travel in one treatment path; separating the smaller pieces and causing them to travel in another wide thin layer in another path; jostling said pieces while in said paths; spraying, upon said first named layer, forceful dynamic jets of a scouring aggregate comprising a mixture of water and fine particles; said jets being continued long enough and being forceful enough and said particles being hard and numerous enough to remove stain from the coal, and soft enough to polish the coal and restore the sheen to the coal; causing said mixture to pass through both layers thereby to remove the stain from and polish the second layer; remixing the coal from said paths; washing the mixture; catching the aggregate as it passes through said layers; agitating and thoroughly mixing the aggregate; and again spraying forceful jets thereof upon the first named layer.

13. In combination, a support for a layer of coal; a reservoir for scouring aggregate; a pump drawing aggregate mixture from the reservoir having its pressure pipe discharging sprays upon the coal; and means for mixing air with the aggregate before its discharge.

14. In combination, an inclined shaking screen; means for discharging coal into the upper end of the screen; means for receiving coal from the screen; a sump bay beneath said screen having a deepest portion; and a pump drawing aggregate mixture from said deepest portion and having its pressure pipe branched to form an agitator pipe discharging into said bay to agitate the aggregate in said deepest portion; said pressure pipe being formed with spray nozzles directing sprays upon the coal in the screen.

15. In combination, an inclined perforated shaking screen; means to supply coal to the screen; and means for discharging sprays upon the coal in the screen; the screen being floored with stepped perforated plates formed with wide approximately horizontal perforated portions and shallow riser portions therebetween; the shaking of the screen gradually projecting coal over the edge of the horizontal portions to cause the pieces to turn over as they leave the horizontal portions.

16. In combination, an inclined perforated shaking screen; means to supply coal to the screen; means for discharging sprays upon the coal in the screen; the screen being floored with stepped perforated plates formed with wide approximately horizontal perforated portions and shallow riser portions therebetween; and a trip means on each wide portion far enough from each riser portion to catch the bottom of, and turn over, pieces of coal shaken from the horizontal portion.

17. A method of scouring coal comprising disposing pieces of coal in air; causing dynamic jets to pass through the air and to impact directly upon said pieces; said dynamic jets comprising a mixture of water and fine particles of coal larger than dust size and ranging up to particles which will just pass through a 3/64 inch mesh; said particles being small and few enough relative to the water for easy spraying and large, hard and numerous enough and projected directly upon the coal with enough force and long enough, to remove stain from the coal, the particles being soft enough to polish the coal and restore the sheen thereto.

18. A method of cleaning lumps of coal which comprises spraying upon the lumps jets of a mixture of fluid and particles of coal ranging from dust sizes up to sizes which will just pass a $\frac{3}{16}$ inch mesh.

19. A method of cleaning coal which comprises scouring the coal with a scouring aggregate including water and particles of coal larger than dust sizes ranging at least up to sizes which will just pass a 1/64 inch mesh; and continuing said scouring a length of time long enough to remove stain from stained coal.

20. A method of scouring stained coal which comprises spraying upon the coal with a scouring aggregate including a fluid and particles of coal larger than dust sizes ranging up to sizes which will just pass a 3/64 inch mesh; and continuing said spraying until the stain is removed from the coal.

21. A method of cleaning dull and stained coal which comprises impacting upon the coal a scouring aggregate including water and particles of coal larger than dust sizes ranging up to sizes which will just pass a $\frac{3}{16}$ inch mesh; and continuing said impacting until the coal is polished and the stain is removed from the coal.

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