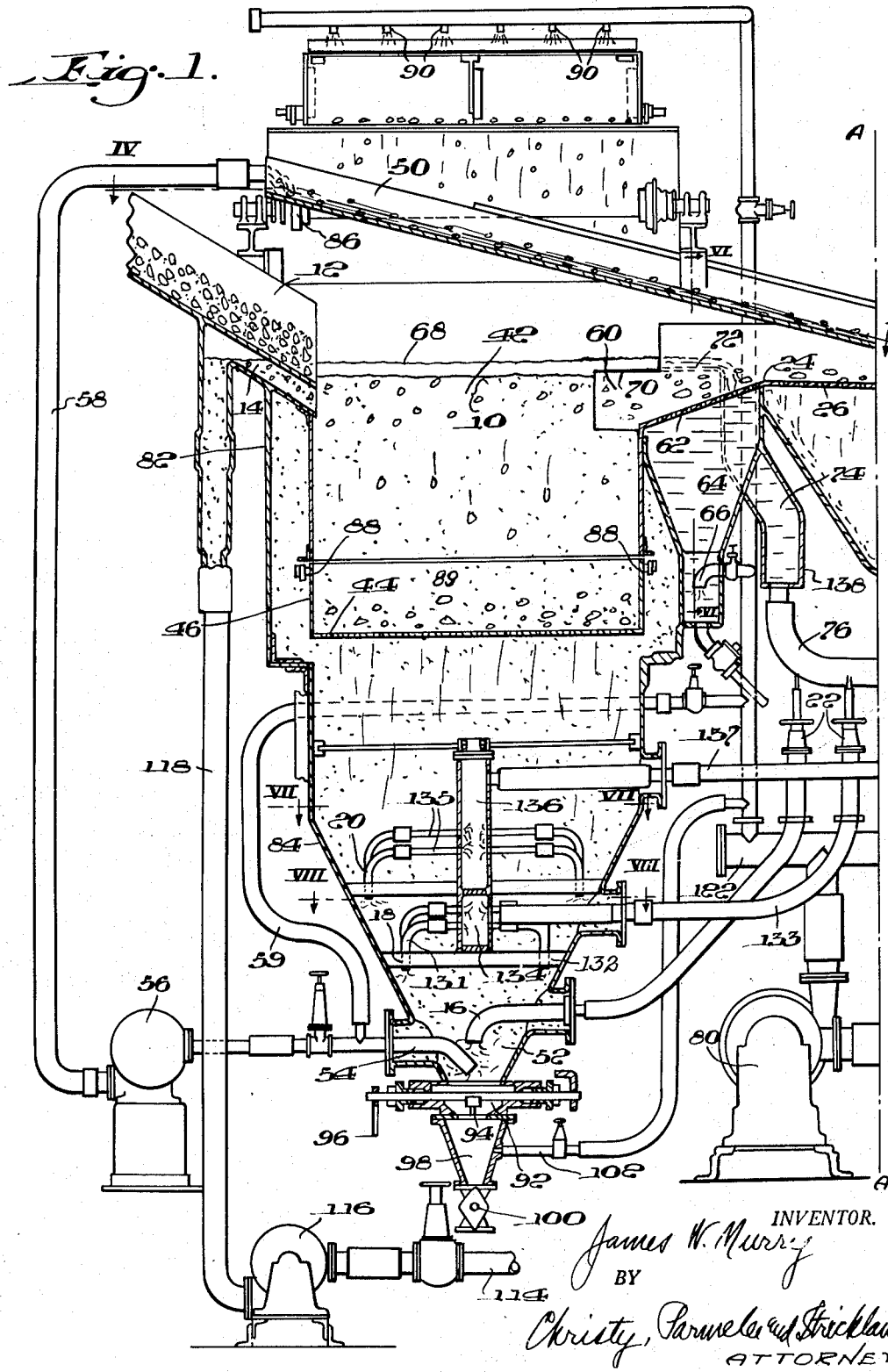
Feb. 7, 1956 J. W. MURRY 2,733,810

COAL CLASSIFICATION

Filed July 2, 1952 6 Sheets-Sheet 1

Fig. 1.



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COAL CLASSIFICATION

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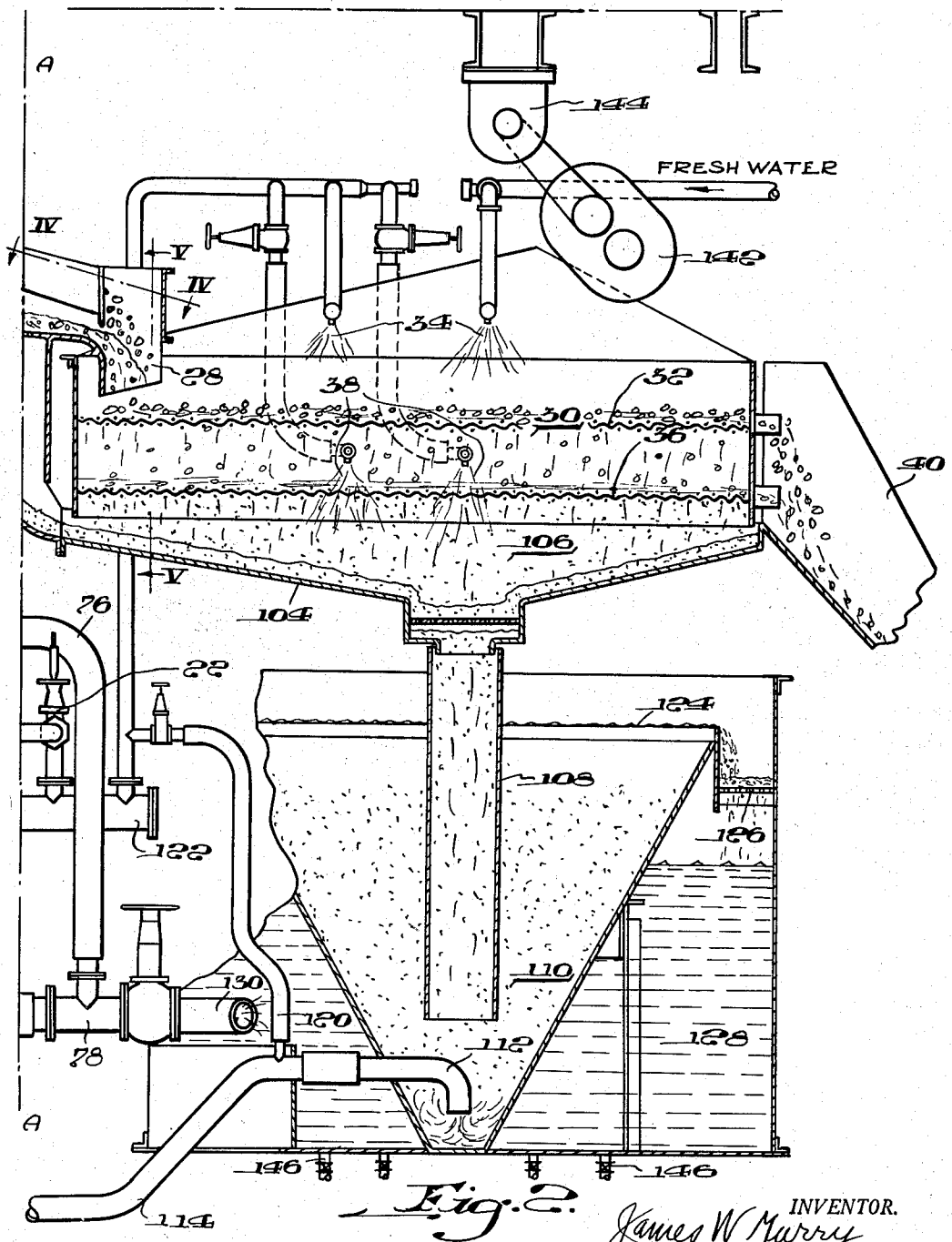


Fig. 2.

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COAL CLASSIFICATION

Filed July 2, 1952 6 Sheets-Sheet 3

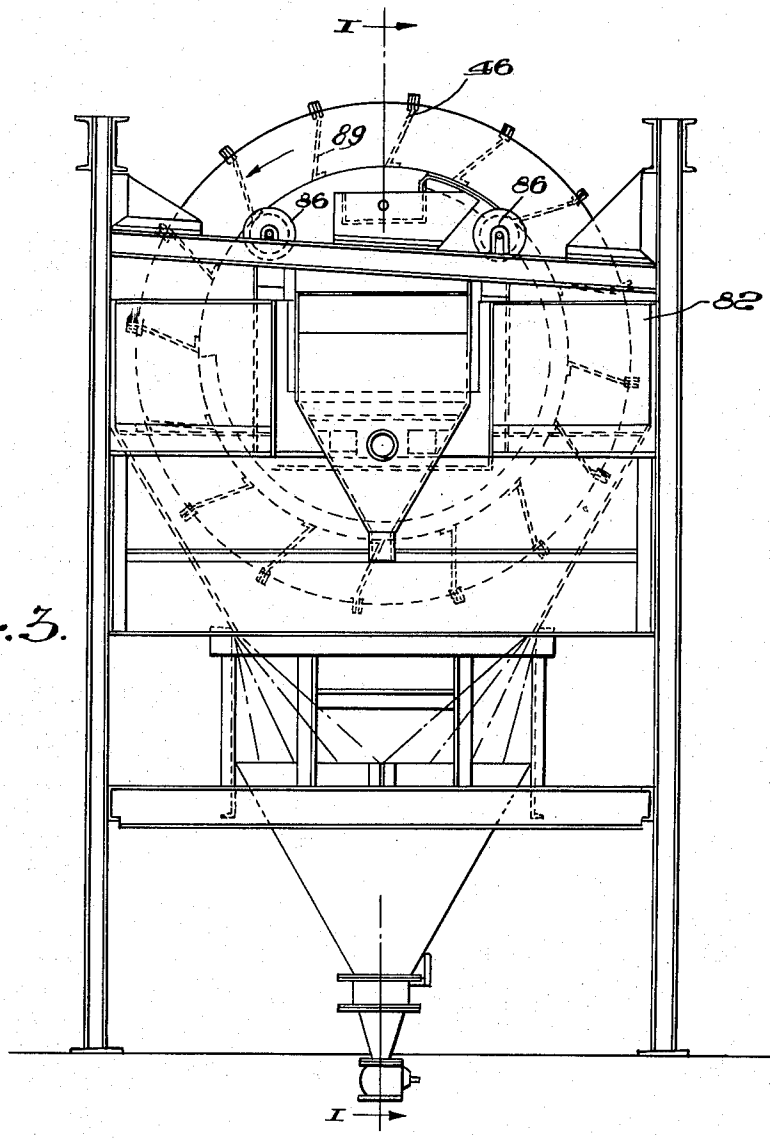


Fig. 3.

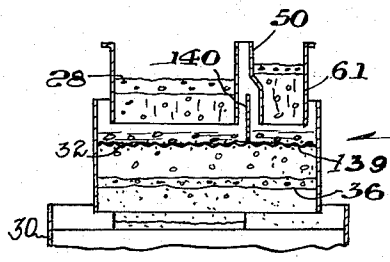


Fig. 5.

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COAL CLASSIFICATION

Filed July 2, 1952 6 Sheets-Sheet 4

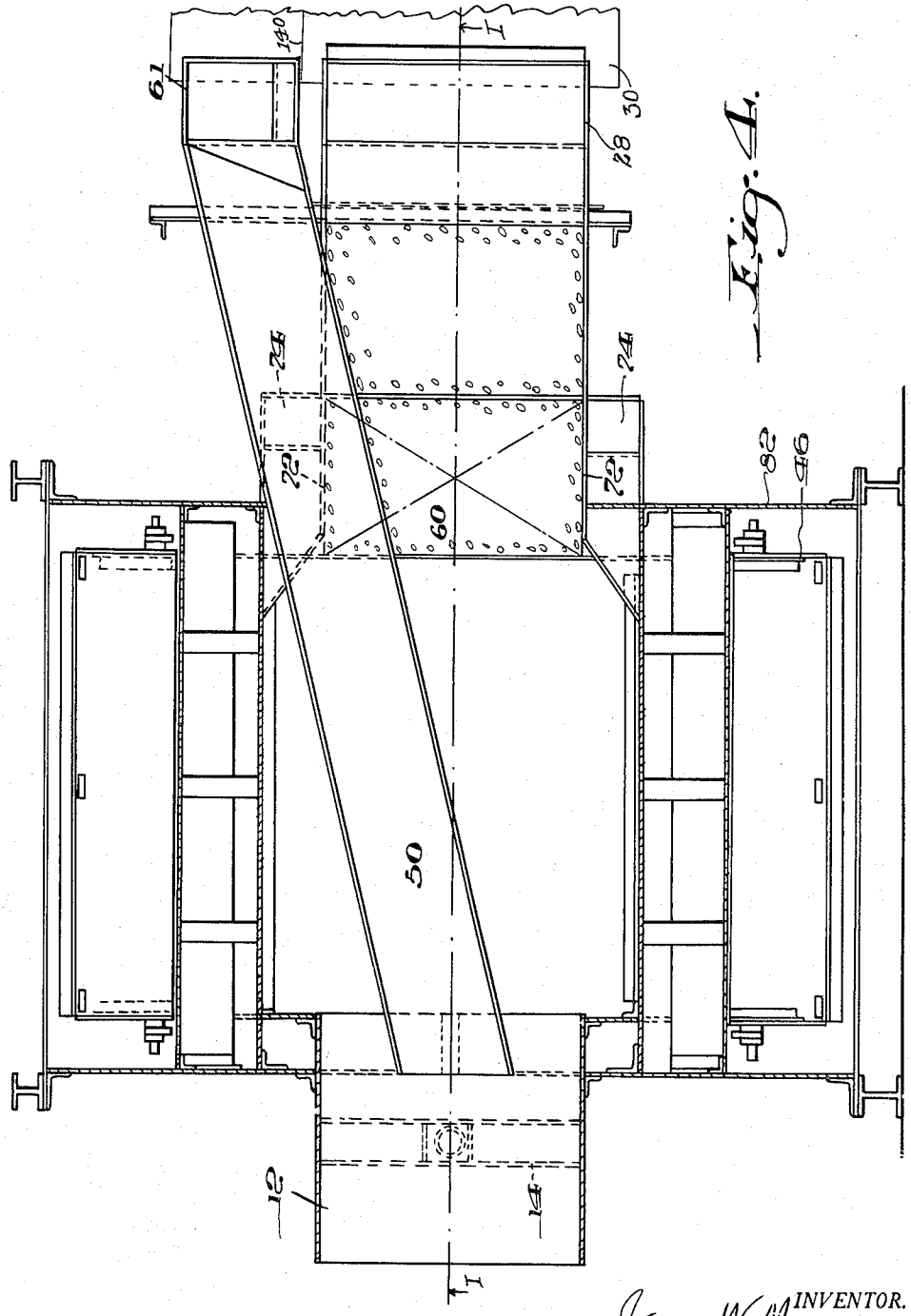


Fig. 4.

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COAL CLASSIFICATION

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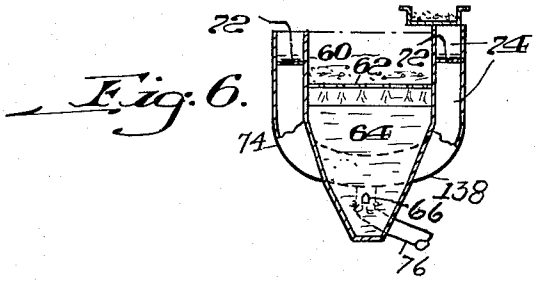


Fig. 6.

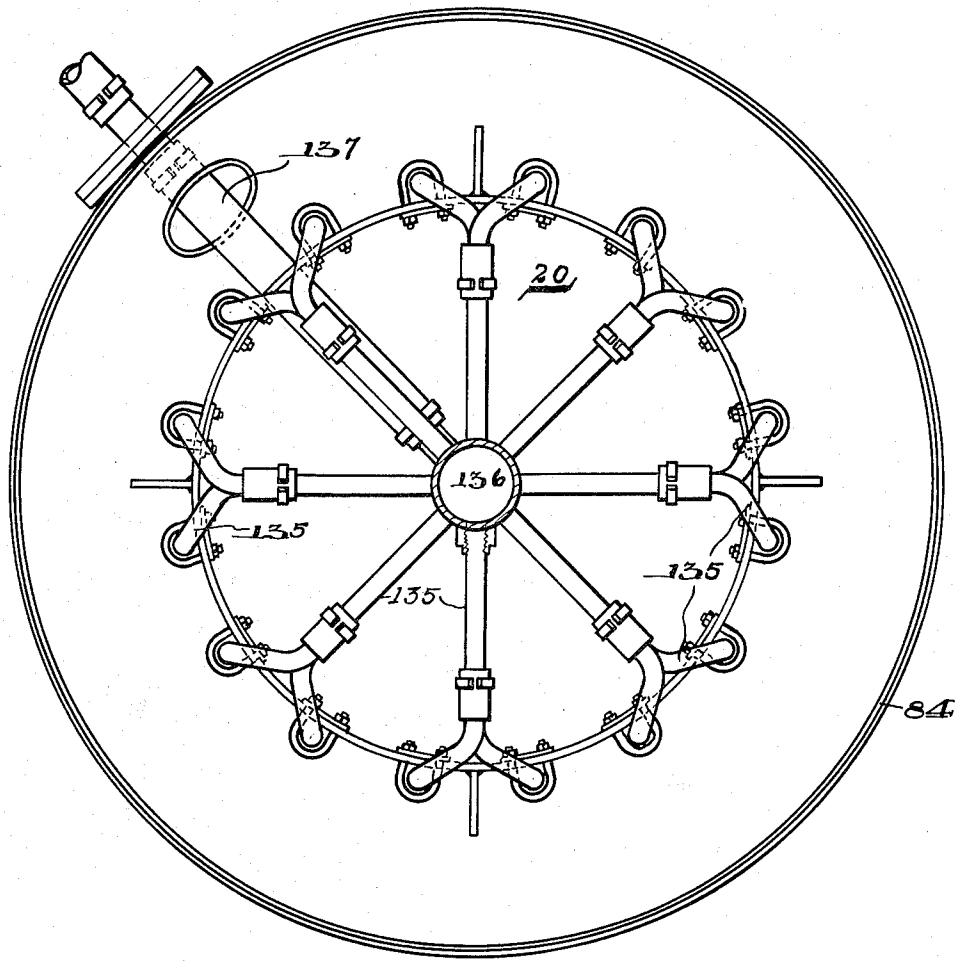


Fig. 7.

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COAL CLASSIFICATION

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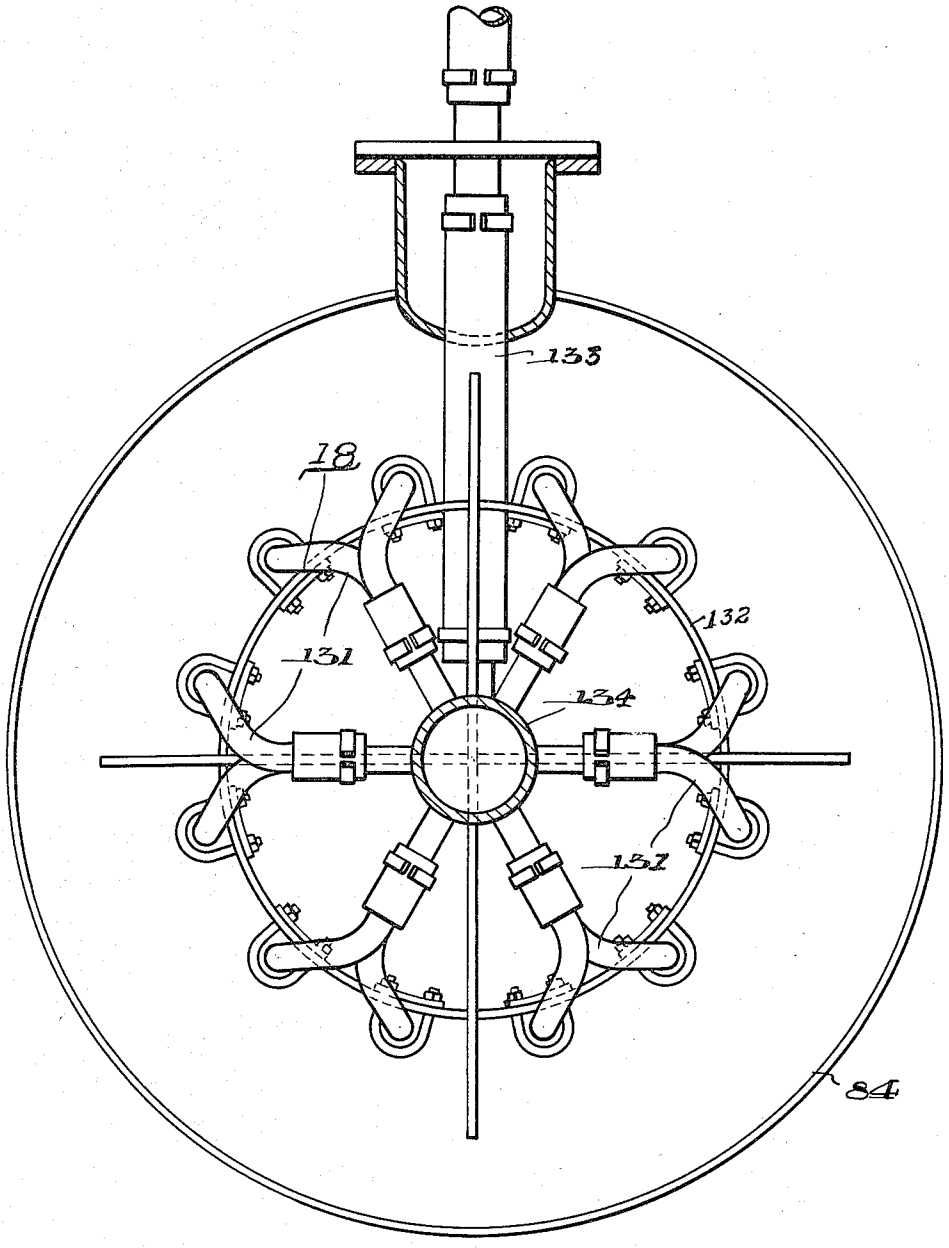


Fig. 8.

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United States Patent Office 2,733,810 Patented Feb. 7, 1956

2,733,810

COAL CLASSIFICATION

James W. Murry, Fairmont, W. Va.

Application July 2, 1952, Serial No. 296,843

9 Claims. (Cl. 209—172.5)

This invention relates to coal classification. More particularly the invention relates to a machine for classifying and washing granular coal to separate slate, rock, bone and heavy mineral matter from burnable coal.

The present invention is a continuation-in-part of my application Serial No. 214,807, filed March 9, 1951, for Heavy Solid Mixture Classification, and now abandoned.

A coal floating mixture of sand and water is used in a classifying compartment in these inventions, to float separate clean coal from refuse. The mixture of sand and water which will properly float the desirable coal is formed in the upper portion of the classifying compartment, and it has been found that the sand-water mixture level will fall as sand is lost from the system. As the floating mixture level falls, it becomes increasingly difficult to pass the clean coal over the weir at the outlet of the classifying compartment, particularly the larger particles of coal.

In the operation of my coal classifier, the coal floating sand-water mixture is formed by introducing sand at the top of the classifying compartment and circulating water up through the compartment to provide a coal floating mixture of a desired gravity. I have found, however, that in maintaining the top level of the coal floating mixture zone sufficiently above the outlet weir to carry the clean coal out of the compartment, a comparatively thick layer of substantially sand-free water is formed above the top of the coal floating mixture. This water passes over the weir with the clean coal, and assists in carrying the clean coal over the weir. If the water and floating mixture levels fall, it is necessary to raise the levels by the addition of sand, and the quantity of water and sand must be controlled to produce a mixture of the desired gravity. A normal low level of the float mixture zone in the compartment outlet makes it difficult to get the float coal out of the machine. When the water and float mixture levels fall below a predetermined point, the large particles will not pass over the outlet weir.

I have found that the normal changes of level of water and float mixture at the top of the classifying compartment may be compensated for by causing the clean floating coal to be propelled up an inclined perforated plate in passing over the weir. It is necessary to have the perforations in the screen sufficiently large so that a stream of water introduced below the screen will pass up through the screen to prevent the sand from settling on the screen, and to provide a water current for carrying the clean coal and its float mixture over the weir.

The primary object of the present invention is to provide a method and apparatus for classifying coal containing large particles to obtain an efficient high capacity coal classification.

Another object of the invention is to provide a method and apparatus by which coal containing large particles may be classified and the clean coal positively moved out of the classification chamber without disturbing the gravity separation being carried on in the classification compartment.

A further object of the invention is to provide a method and apparatus for coal classification to separately recover the clear water strata which rises above the sand-water float mixture for floating the clean coal.

Heretofore in those coal washers which use a sand-water mixture for classifying coal, it has been the practice to overflow the supernatant layer of water above the level of the sand-water coal floating mixture with the coal and sand, and send the water to a sand separating sump to be recovered. I have now found that the clear water layer above the sand-water coal float mixture may be separately collected adjacent the classification compartment outlet and returned directly to the water circulating pump. This greatly reduces the size of the sand separator.

Another object of the invention is to provide an improved water distributing apparatus for the classifying compartment to assist in obtaining the coal classification and maintaining the desired floating level of the sand-water mixture.

A further object of the invention is to provide an apparatus by which heavy solids such as iron, copper, or metals and heavy residue, which will not circulate in the classifier as sand and ordinary refuse may be circulated, may be removed from the classifying compartment without interrupting the classification operation.

With these and other objects in view, the invention consists in the improved sand-water coal floating mixture classification method and apparatus as hereinafter illustrated and described, and specifically defined in the appended claims.

The various features of the invention are illustrated in the accompanying drawings, in which:

Figs. 1 and 2 are a vertical sectional view taken on the line I—I of Fig. 3, of the preferred form of coal classifier of the present invention, each figure showing a part of the apparatus section as divided along the line A—A;

Fig. 3 is a view in side elevation of the apparatus shown in Fig. 1;

Fig. 4 is a sectional plan view taken on the line IV—IV of Figs. 1 and 2 of the classifying compartment, showing the refuse chute and the coal dewatering screen;

Fig. 5 is a vertical sectional view taken on the line V—V of Fig. 2, showing the coal and refuse classifying and dewatering screens;

Fig. 6 is a vertical sectional view taken on the line VI—VI of Fig. 1, showing the clear water overflow tubes and the water circulating compartments below the inclined perforated plate at the outlet of the classifying compartment; and

Figs. 7 and 8 are vertical sectional views taken on the lines VII—VII and VIII—VIII of Fig. 1, showing the water distributing apparatus in the bottom of the classifying compartment.

The present invention employs an improved method of float separation of coal which permits the use of a comparatively small classifying compartment for classifying coal while operating on large size coal. The method may be briefly outlined by reference to Figs. 1 and 2. The coal to be classified is introduced into a classification compartment **10** through a chute **12**. The chute **12** discharges into the top of the compartment into a sand-water float mixture of desired density for floating the desired clean coal. The sand for producing the sand-water float mixture is introduced through a chute **14** immediately below the coal chute **12**, and water to produce the sand-water float mixture is introduced to the bottom of the compartment through inlets **16**, **18** and **20** to provide an upward current of water to suspend the sand in the compartment. The velocity and volume of water are controlled by means of valves **22** to control the density

of the sand-water float mixture throughout the compartment 10 so as to provide a zone in which the heavy bone and refuse may sink to be separated from the desired coal. As the water reaches the top of the classification compartment, it moves transversely of the compartment to a weir 24, and the float mixture with float coal pass over the weir across a screen 26 to a chute 28 and then onto a desanding screen 30. The coarse coal remains on a top screen 32 and is washed by water sprays 34. Fine coal which passes through the screen 32 to a screen 36 is washed by sprays of water 38. Fine and coarse coal is discharged into a chute 40.

The velocity of the movement of the water and float mixture with the float coal across the top of the classification compartment is such that the heavy fine and coarse refuse in the coal sinks below a float mixture zone 42 before the clean coal reaches the weir outlet. As the refuse sinks, the coarse refuse is caught by a screen 44 which forms the bottom of an elevator 46 which is constantly rotated to carry the coarse refuse to the top of the tower, where it is discharged into a refuse chute 50. The perforations in the screen 44 are sufficiently large to permit the fine refuse and sand to pass through them. The amount of sand in the water decreases downwardly from the screen 44 and fine refuse sinks through the water to the bottom of the compartment to a settling chamber 52. The fine refuse, together with water, is drained out of the chamber 52 through an outlet pipe 54 by a pump 56 and circulates through a pipe 58 up to the chute 50 to be mixed with the coarse refuse. To prevent the outlet line 54 from becoming clogged, a water line 59 connecting with line 54 permits water to be introduced into a line 54 to keep the fine refuse mobile. The coarse and fine refuse flow down through the chute 50 to a chute 61, and are discharged onto the screen 139 as illustrated in Fig. 5.

To assist in carrying the large pieces of the desired clean coal out of the classification compartment, the float mixture in the compartment passes into a chamber 60, which extends along the side and sufficiently below the top of the compartment to receive the float mixture of desired density with the floating coal therein. The bottom of the chamber 60 is a screen 62 across which the float mixture and coal pass in going over the weir 24. Water is introduced into the bottom of a distributing chamber 64 through a pipe 66 and flows up through the chamber and through the screen 62 to prevent sand from settling on the upwardly sloping plate 62. This means of keeping the sand and water moving out of the classifying compartment in a mobile condition is an important feature of the present invention, in that it prevents sand from settling on the plate 62 and the blocking of the discharge over the weir and facilitates carrying large size coal lumps over the weir.

When forming the sand-water float mixture of desired density in the upper portion of the compartment, I have found that a layer of water 68 (Fig. 1) is formed, above the float mixture layer, which may be several inches in depth, that is comparatively clean water. This layer of water passes with the float mixture and coal across the top of the compartment and is controlled so that it does not enter the chamber 60 but passes across the top 70 of the chamber 60 to side water outlet weirs 72. This water is comparatively free of sand and refuse and is passed across the weir to collecting tubes 74 at each side of the compartment, and is carried by a tube 76 to a manifold 78 and thence to a water circulating pump 80 which supplies the water introduced into the bottom of the compartment 10 through the inlets 16, 18 and 20.

Referring to Figs. 1 and 3, the coal classification tower 82 has a rectangular section at the top which houses the classifying compartment 10, and a conical bottom 84 in which the water circulation inlet pipes are located. The elevator 46 is mounted in the top of the tower and is supported on rolls 86 which are positively driven to rotate the elevator. The elevator consists of the annular screen 44 attached to inwardly projecting flanges 88 at each side of the screen, and the flanges ride upon the rolls 86 to support the elevator. Perforated plates 89 are secured to the screen 44 between the flanges 88 to help hold the coarse refuse in the elevator until it is brought into position for discharge. A series of water sprays 90 are positioned above the elevator 46 to direct water against the outside of screen 44 to wash the coarse refuse out of the elevator into the chute 50. The chute 50 is inclined downwardly as illustrated in Figs. 1 and 2 so that the coarse refuse is carried by gravity and water to the distributing chute 61 (Fig. 5).

The coal feed may contain metal particles such as iron, steel and copper which are so heavy that they cannot regularly be circulated through outlet 54 and pump 56 to the refuse chute 50. These heavy materials accumulate in a pocket 92 below the chamber 52 and periodically a door 94 may be opened at the bottom of the cone 84 by means of a hand-lever 96 to allow these heavy particles to drop into a trap 98. Periodically the door 94 is closed and a valve 100 will be opened while water is introduced into a valved line 102 to flush heavy particles out of the trap 98. The operation may be carried on while the coal classifying is continued.

In the operation of the coal classifying apparatus, the only sand introduced into the classifying compartment is introduced through the chute 14, and this sand is carried out of the compartment with the clean coal, and the sand is separated as the coal passes across the screens 32 and 36. After the sand passes through the screens 26, 32, 36 and 139, it is washed across the bottom 104 of a desanding funnel 106 to a stand pipe 108. This sand and water then passes down through the pipe 108 into a sand sump 110 where the sand is separated from the water. The sump 110 has an inverted cone shape with a sand collecting compartment at the bottom of the cone, into which an outlet pipe 112 opens. Sand may be drained through the outlet 112, then through a pipe 114 to a sand pump 116, which circulates the mixture of sand and water upwardly through a pipe 118 to the chute 14. To insure that the outlet 112 and pipe 114 do not become clogged, water may be introduced into the pipe 114 through a valved line 120 which is connected with a water manifold 122. It is only necessary to introduce water through the line 120 to establish a flow of sand and water to the pump 116, and ordinarily the pump will draw a water-sand slurry from the sump 110 to maintain the circulation after the slurry has once started to flow.

Some sand is lost with the refuse and coal and through the trap 98. To maintain the sand-water float mixture at the proper level in the classifying compartment, sand must be introduced to hold a substantially uniform amount of sand in the classifying circuit. This sand is preferably added to the sand sump 110. Any added sand which reaches the compartment is distributed by the water introduced through inlets 16, 18 and 20. This water controls the specific gravity of the float mixture and as extra sand is added the float mixture level is raised.

The water separated in the sand sump 110 overflows a weir edge 124 at the top of the inverted cone, and then flows down through a screen 126 into a collecting chamber 128 formed around the sump. Chamber 128 forms the main source of water for carrying out the classification operation. This water is drained from the chamber 128 through a valved outlet pipe 130 to the manifold 78 connected to the pump 80, and then circulates to the manifold 122 by which the water for all of the operation is distributed. Fresh water to make up losses is supplied to one of the sprays 34 used to remove sand from the cleaned coal.

Referring more particularly to Figs. 1, 7 and 8, the water distribution apparatus for the coal classification compartment is illustrated in detail. A downwardly

opening inlet nozzle pipe **16** is located at the bottom of the cone **84** of the classification compartment. This inlet pipe distributes water over circular area and then the water moves upwardly through the cone. The inlet **18** is illustrated more particularly in Fig. 8 and consists of a series of downwardly opening inlet nozzles **131** which are supported on an annular frame **132** mounted in the mid portion of the cone **84**. Water is introduced from the manifold **122** through a pipe **133** to a distributor **134** (Fig. 1) supported at the center of the cone. The water flows from the distributor **134** through the nozzles **131** to be introduced into the cone over an annular area outside of the area of the water introduced by the pipe **16**. The size of the nozzles **131** and the velocity of the water introduced through the valve line **133** distributes the water around the bottom of inlet **18** to cover an annular zone which will co-act with the water introduced through inlet **16** to fill the bottom portion of the cone **84** with an upwardly flowing body of water.

The water inlet **20** illustrated in Fig. 7 consists of a series of nozzles **135** which are connected to a distributing manifold **136**. Water is supplied to manifold **136** through a valved pipe **137**, and is distributed across the cone to co-act with the water which is rising from the inlets **16** and **18** to provide a stream of water which rises at a uniform rate across the entire area of the cone above the inlets **20**. By this arrangement of inlets, a body of water flowing upwardly at a uniform rate is maintained in the classifying compartment to provide a zone in which the heavy refuse will sink, and which will carry and hold the sand at the desired level in the zone **42** for floating the coal out of compartment **10**. The velocity and volume of water introduced through the inlets will hold the sand in compartment **10** and maintain the desired specific gravity.

In Figs. 1 and 6 is illustrated the relation of the chamber **60** and distributor **64** for propelling the coal and sand out of the chamber across the weir **24**. From Fig. 6, it will be seen that a water weir **72** is positioned at each side of the chamber **60**, across which clear water flows into a tube **74** at each side of the chamber. The tubes **74** are connected to a junction box **138**, which in turn is connected with the pipe **76**.

As shown in Figs. 1, 2, 4 and 6, the chute **50** extends through the elevator **46** and is connected with discharge chute **61** (Fig. 5). The discharge chute **61** discharges the waste refuse on a screen **139**, and a division plate **140** is mounted above the screen **139** to prevent the waste refuse from becoming mixed with the clean coal which is deposited on the top screen **32** by chute **28**. The screen **139** below distributing chute **61** is comparatively fine so that practically all of the waste refuse passes across the screen **139** to be discharged. When fine refuse passes through the portion of screen **139** below the chute **61**, it will also pass through the screen **36**. The fine refuse, as well as the fine coal which passes through the screen **36**, and also sand discharged with coal and refuse, will flow into funnel **106** to be disposed of in the sand sump. The screens **32**, **139** and **36** are movably mounted, and the clean coal and refuse are propelled across the screens by means of a shaker **142** which is operated by a motor **144**.

Some fine coal and some fine refuse passes with the sand and water through the de-sander and into the sand sump. Although some fine refuse may be circulating with the sand back to compartment **10**, most of the fine refuse and fine coal which gets into the sand sump will rise with the water in the sand sump and overflow the weir **124**. Such fine coal and refuse will accumulate in the bottom of the chamber **128** and may be periodically withdrawn through valved outlets **146** (Fig. 2).

Since all liquids handled through the piping will contain some sand, fine coal or other abrasive material, rubber hose will stand this abrasion better than steel pipe, and is therefore preferably used.

The specific embodiment of the present invention is illustrated and described as applied to the washing of coal to separate clean coal from refuse. The main features of the invention, however, are applicable to the classification of many types of solid mineral matter to separate a solid of desired density. With sand and water, a sand-water float mixture may be formed in the classifying compartment to obtain a slurry having an average specific gravity in the range of 1.35 to 1.65, and thus adapt the method and apparatus for classifying many types of solid materials.

The preferred form of the invention having been thus described, what is claimed as new is:

1. A method of classifying coal comprising introducing sand in the top of a coal classifying compartment, passing a body of water upwardly and across the top of the compartment then over an outlet weir, regulating the volume of sand and the upward velocity and volume of water being circulated to keep the sand suspended in the water and to maintain a sand-water float mixture zone in the top of the compartment having a specific gravity adapted to float the desired coal, introducing granular coal to be classified into the sand-water float medium at the top of the compartment, maintaining a sand-water mixture of downwardly decreasing specific gravity below the coal floating zone of the compartment to facilitate the separation of heavy sink material, permitting heavy refuse to sink through the compartment, screening the sinking refuse to catch the coarse material and carrying it out of a mid-portion of the compartment while allowing fine heavy sinking refuse to pass through the screen, withdrawing fine refuse from the bottom of the compartment, carrying the float coal with the float mixture in a confined stream up an inclined perforated base with increased velocity to and over the outlet weir by introducing water at the bottom of the stream through the base to keep the water, sand and coal mixture mobile and prevent sand from settling on the base.

2. The method of classifying coal as defined in claim 1 in which a layer of substantially clear water moves across the classifying compartment with the coal and float mixture, separately withdrawing the clear water adjacent the float coal outlet, and directly returning the water to the water circulating system.

3. The method of classifying coal as defined in claim 1 in which the sand propelling water passing into the stream passing over the weir has its velocity and volume controlled independently of the water passing through the classifying compartment.

4. A coal classifying machine comprising a classifying tower having a separate classifying compartment in the upper portion of the tower, a conical bottom for the tower symmetrically positioned below the compartment, a cylindrical screen rotatably mounted in the tower to surround the compartment with the screen closing the bottom of the compartment, a chute to introduce sand and granular coal directly into the top of the compartment, an outlet weir for clean coal, water and sand mounted in the tower opposite said chute and communicating with the inside of the classifying compartment, a series of water inlet nozzles positioned within the cone below the compartment for introducing water to the sand within the compartment, each nozzle being connected with a distributor and shaped to distribute water over a portion of the cross sectional area of the top of the cone with the nozzles being arranged to provide a substantially uniform distribution of water over the entire cross sectional area at the top of the cone, and means to control the volume and velocity of flow of water to the nozzle distributors.

5. The coal classifier defined in claim 4 in which the nozzles are arranged in different vertical levels and the area of distribution of water from the nozzles overlap to give a substantially uniform upward flow rate of

water throughout the cross-sectional area of the cone at different vertical levels and through the classifying compartment.

6. The coal classifier defined in claim 4 in which a pocket for collecting fine and heavy refuse is located in the bottom of the cone, an outlet pipe opens into the pocket, a refuse pump is connected with the outlet pipe to withdraw fine refuse, and a double door trap is positioned below and communicating by one door with said pocket for the withdrawal of refuse too heavy to be circulated through the outlet pipe by the pump.

7. In a coal classifying machine comprising a deep compartment for a classifying solution, inlets for coal and sand at the top of the compartment, an overflow weir for the compartment opposite the inlets, a pump and piping to introduce water at the lower portion of the compartment arranged to produce an upwardly flowing body of water to rise through the compartment at a uniform rate over the area of the compartment to form a sand-water float mixture zone in the compartment and cause the flowing body to cross the top thereof and flow over the weir, an overflow chamber adjacent the weir positioned so that the bottom is at a level to receive the sand-water float mixture and coal floating therein, the bottom plate of said chamber being upwardly inclined from a point near the inlet thereof to the weir, perforations in substantially the entire area of the inclined bottom, a water distributor below the perforated plate, and means to circulate water through the distributor and plate with a velocity to assist in carrying coal and sand up the plate and over the weir.

8. The coal classifying machine as defined in claim 7 in which the top of the overflow chamber is slightly above the top of the maximum height to be attained by the sand-water float zone layer, and weirs are positioned at the sides above the top of the chamber for the collection of clear water rising above the sand-water float zone, and means to conduct water overflowing the clear water weirs back to the water circulating means.

9. The coal classifier defined in claim 7, in which the overflow chamber has a width approximately equal to the width of the compartment, and the top of the water distributor has an area substantially equal to the area of the plate to agitate and propel solids over substantially the full area of the plate.

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