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H. A. STROHL, SR

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RECOVERY OF COAL

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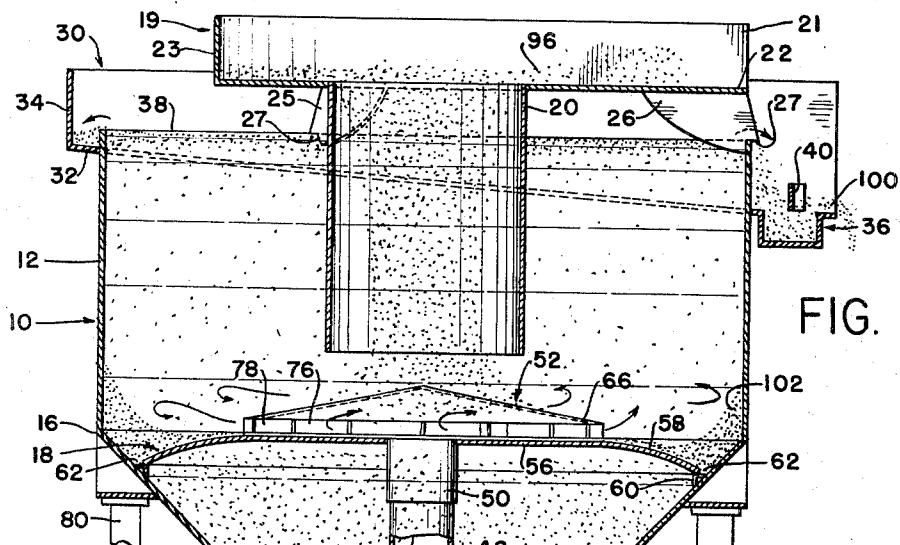


FIG. 1

FIG. 3

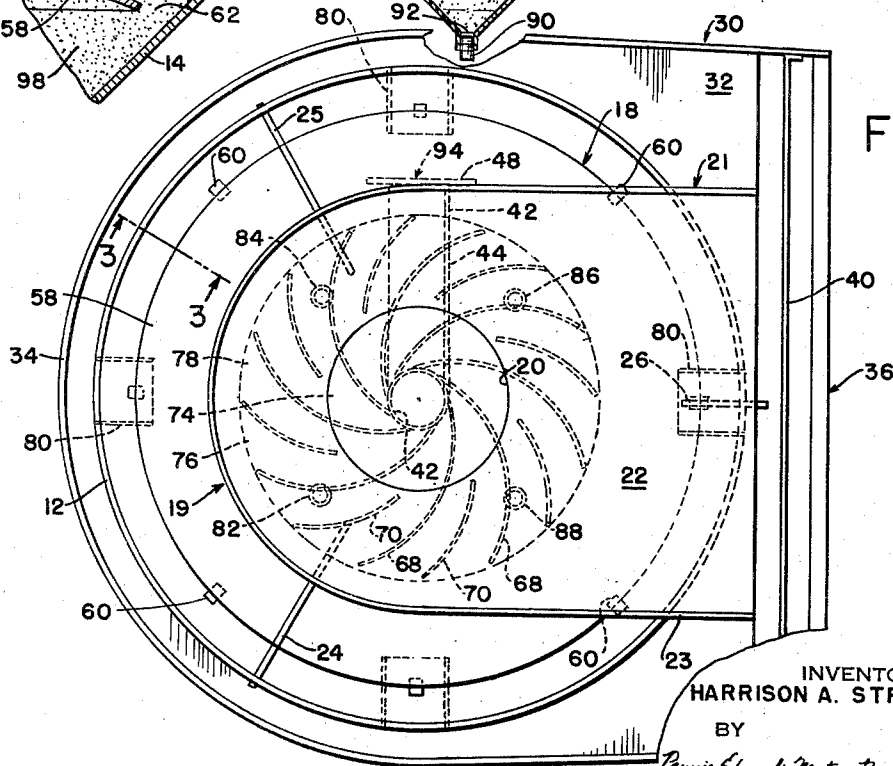
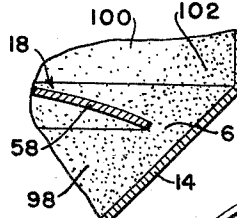


FIG. 2

INVENTOR
HARRISON A. STROHL, SR.

BY

Pennie, Edmunds, Morton, Benson & Taylor
ATTORNEYS

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RECOVERY OF COAL

Harrison A. Strohl, Sr., Nesquehoning, Pa., assignor to Menzies Engineering Company, Pottsville, Pa., a partnership composed of A. Harold Leisawitz and Bernard A. Moser

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4 Claims. (Cl. 209—159)

This invention relates to the recovery of coal and has for its object certain improvements in the method of and apparatus for effecting that purpose.

Before preparation plants for cleaning, sizing and washing coal came into vogue, the consumer received his coal as it came from the mine; laborers who did the loading underground picked out such impurities as shale which caught their eyes. This run-of-the-mine coal was a conglomerate mass of fines, small, medium and large, as they emerged from the mine and were loaded into railroad cars without any sorting or any processing. As time went on different types of consumers and varying types of coal-burning mechanisms required particular sizes of coal. As a result of this requirement plants for cleaning, sizing and washing the coal were developed.

This preparation of coal for market depends essentially on the fact that the density of coal is less than that of the rocky impurities embedded in it. Natural impurities, therefore, can be removed in large part by gravity processes. In anthracite mining, the cleansing or preparation plant is called a breaker; and in bituminous a tippie. The former gets its name from the fact that coal is broken, sized and cleaned in the breaker. The latter gets its name from the fact that cars filled with bituminous coal are tipped or dumped to the top of the cleansing plant.

Inside of the breaker or tippie many types of machines are employed to clean, wash and break the run-of-the-mine coal and to separate rock, slag, slate and other impurities therefrom. As indicated, the broken up coal is washed to separate the valuable coal particles from the impurities, the resulting coal particles being screened to divide them into various commercial sizes such as grate, broken, egg, stove, nut, pea, buckwheat, rice, barley, etc.

While the cleaning operation is highly effective, a very substantial amount of the small particles of coal are lost. They and the impurities, often referred to as refuse or gangue, were formerly dumped into a stream of water and carried into rivers. This resulted in a pollution of the stream and the practice is now prohibited by statute in a number of states. The mixture of coal fines and refuse is now usually conducted to a culm dump or bank, which is a storage dump or waste heap where the culm is accumulated. Various proposals have been advanced to recover the valuable coal fines in these culm dumps or banks. The present invention is concerned with improvements in the method of and apparatus for effecting that purpose.

The invention will be better understood by referring to the accompanying drawing, taken in conjunction with the following description, in which:

Fig. 1 is a side elevation in section of an apparatus illustrative of a practice of the invention;

Fig. 2 is a plan view of the apparatus; and

Fig. 3 is an enlarged section on the line 3—3 of Fig. 2.

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The apparatus shown includes a vessel 10, shaped generally like a cyclone, formed of an upper cylindrical tank 12, and a lower inverted conical hopper 14, the two being integrally secured to each other at their line of juncture 16. The tank and hopper are separated generally by a diaphragm 18.

A removable feed well 19 is disposed in the uppermost portion of the tank. It includes a centrally positioned cylinder 20, to the upper end of which is secured a feed launder 21, having an elongated bottom 22 and a side wall 23 to direct culm into the cylinder. A plurality of spaced lateral supports 24, 25, 26 are secured to the bottom. Each support is provided with a placement notch 27 adapted to fit on the upper rim of tank 12, to hold the feed well as a whole in fixed operative position.

An inclined discharge launder 30, formed of a bottom 32, a side wall 34, and a trough 36, is integrally secured to and exteriorly of the uppermost portion of the tank. As one views Fig. 1, it will be noted that the high point of the bottom of the launder is to the left of the tank, the bottom being just below the top of the tank; that the low point of the bottom of the launder is to the right of the tank, the bottom being well below the top of the tank; that this arrangement gives the bottom of the launder a substantial incline downwardly from left to right; that the upper rim 38 of the tank defines a circular overflow lip for the coal fines; and that the overflowed coal fines can drop into the launder and find their way by gravity down the inclined launder to the trough. A baffle plate 40 extends lengthwise above the mid portion of the trough, being fastened at its ends to the side wall of the launder. It acts to prevent over-surges of coal fines and water from shooting completely over and out of the trough.

Going next to the conical hopper (Figs. 1 and 2), it is provided with a water inlet 42 with a horizontal arm 44 extending from the outside to the central portion of the hopper and with a vertical arm 46 rising in the hopper toward the cylindrical drum. The outer end of the horizontal arm is fitted with a mounting flange 48 to make connection with a source of water, not shown. The upper end of the vertical arm (Fig. 1) fits into a sleeve 50 integrally secured to diaphragm 18, which extends across the tank and hopper and to a stationary gyrating device 52 positioned in the lowermost portion of the tank (Fig. 1), directly above the hopper.

Diaphragm 18 (Fig. 1) is in the form generally of a dome, having a central flat portion 56 to support the gyrating device and an outer curved portion 58 extending downwardly a short distance into the hopper. The diaphragm is supported on a plurality of lugs 60 extending inwardly of and spaced circumferentially around the upper portion of the hopper. The lugs are integrally secured to the hopper. As will be noted more easily in Figs. 1 and 3, the outer peripheral portion of the diaphragm extends to the lugs but not to the hopper, thus providing an annular opening 62, adapted for the passage of refuse from the tank to the hopper. The annular opening of course extends circumferentially around the diaphragm and the contiguous portion of the hopper.

The stationary gyrating device may be considered generally as a hollow cone, formed of a dome or hood 66, resting above a plurality of vertically disposed and laterally spaced swirl plates 68, 70. They are curved in the instant construction, as one looks down into the tank, to impart a clockwise swirling motion to water passed therebetween. It will be noted (Fig. 2) that plates 68 radiate tangentially from the outlet of sleeve 50, and that plates 70 alternate with those plates, being shorter, about one-half as long, extending to the periphery of the gyrating

device. The plates are equally spaced from each other. Long plates 68 form initial inner passageways 74, which are in turn sub-divided into outer passageways 76 and 78 by short plates 70.

Vessel 10 is as a whole carried by a plurality of spaced supports 80 extending circumferentially around the upper portion of the hopper. The hopper itself is provided with a plurality of outlets 82, 84, 86, 88 circumferentially spaced around the hopper in its lower intermediate portion. These outlets may be in any advantageous form, such as nipples provided with plug valves 90 so that the escape of refuse and water from the hopper can be controlled. A similar outlet 92 is provided at the inverted apex of the conical hopper.

In a present practice of the invention, the over-all height of the vessel, exclusive of the feed launder, is 10' 6", the hopper being 4' 10" high and the cylindrical tank plus launder being 5' 8" high. The tank has an inside diameter of 10' 0". The gyrating device has a diameter of 5' 6", and a height above the diaphragm of 0' 9". The swirl plates are 0' 3" high, thus providing outlets from the gyrator, between the swirl plates, of the same height. Annular opening 62 adjacent the periphery of the diaphragm has a width of 1 1/4", through which refuse is dropped from the tank to the hopper.

The apparatus described may be operated as follows:

Water 94 is conducted through water inlet 42 in substantial amounts. In present practice this is of the order of 2300 gallons per minute, the amount being adjusted to meet coal recovery requirements. The water rises into gyrating device 52, and passes through passageways 74, 76, 78 between swirl plates 68, 70. A swirling clockwise motion is imparted to the water in the lowermost portion of tank 12. The tank fills up and water overflows into the discharge launder; however, the water in the uppermost portion of the tank is relatively quiescent so far as swirling is concerned. In other words, the swirling action is confined to the area immediately around and adjacent the gyrating device.

Some of the water passes through annular opening 62 from the tank to hopper 14, both of them filling up and overflowing. The water in the hopper is relatively quiescent. Water rising in the tank overflows its upper rim 38, into launder 30, into and out of trough 36. Most of the water overflows the tank, very little sinking to the hopper.

The culm is specially screened, on vibrating screens, to eliminate solids larger than Nos. 4, 5 and 6. Method and apparatus for that purpose form no part of the present invention. With feed well 19 in operative position, as shown in Figs. 1 and 2, the screened culm 96, containing both coal and refuse, is passed into feed launder 21, with the aid of some water. The screened culm drops into cylinder 20 toward dome 66 of gyrating device 52, much of it falling on the dome itself; and is spread out laterally into the swirling body of water in the tank. As suggested above, vessel 10 as a whole is shaped and functions somewhat like a cyclone. Instead of being suspended in a swirling body of gas, the culm solids, refuse 98 and coal fines 100, are suspended initially in the swirling body of water at the bottom of the tank. The heavier particles, due to the centrifugal force with which they are driven, find their way quickly to the side wall of the tank and the upper portion of the hopper; some of them tend to slide over the outer curved portion 58 of diaphragm 18 toward its periphery; and they then sink by gravity toward, into and through annular opening 62 into the hopper. The refuse solids are permitted to collect in the hopper until it fills up. As shown in Figs. 1 and 3, the refuse solids tend to form a bank 102 around the periphery of the diaphragm and against the side wall of the tank, over the annular opening. The extent and size of the bank are determined from time to time by the operator. To this end he inserts an elongated stick into the tank adjacent the side wall and

"feels" the bank. The refuse solids in the bank tend to be compacted, compared with the refuse and coal solids in movement adjacent thereto. The bank, of course, builds up only after the hopper is filled with solids, the bank really forming an outer extension of the body of solids in the hopper. Refuse solids are withdrawn continuously through outlets 82, 84, 86, 88 and 92, together with a small amount of water. As they are withdrawn, refuse solids from the bank drop through the annular openings into the hopper. The bank is in this manner undergoing continuous break-down and build-up. The rate of withdrawal of refuse solids from the hopper is controlled by regulating plug valves 90 so as to maintain a bank of predetermined optimum size.

The smaller, lighter, coal fines are caught up by the rising water and carried to the top of the tank, where they overflow upper rim 38 into launder 30, and then into and out of trough 36. Since the coal fines are thoroughly agitated and mixed in the swirling water in the bottom of the tank, they are thoroughly cleaned of adhering mud, silt and the like. The rate of withdrawal of the fines from the tank is regulated in part by regulating the rate of culm feeding, rate of water flow, and rate of refuse withdrawal from the hopper. The coal fines and water are passed from the trough to screens, not shown, where the fines are separated into various sizes. In a present practice the fines are separated into No. 4, No. 5 and No. 6 anthracite coal.

The present apparatus is being fed with culm at the rate of 130 tons per hour, and with water at the rate of 2300 gallons per minute to effect a very good separation of the coal fines from the refuse solids. Once plug valves 90 in the hopper, are regulated properly, the rate of water feed and the rate of culm feed are brought into balance, the apparatus may be operated continuously with little or no further attention to those variables.

It will be clear to those skilled in this art that the above described example is by way of illustration and that the practice of the invention lends itself readily to a number of useful modifications.

I claim:

1. In apparatus for recovering coal by gravity separation, the improvement comprising a tank for separating refuse solids from coal fines, a feed well positioned in the tank for feeding a mixture of coal fines and refuse solids into the tank, a gyrating device having a central water inlet, said device being located in the lower portion of the tank for feeding water into the lowermost portion of the tank in a swirling movement, a plurality of spaced and curved swirl plates radiating outwardly from said water inlet, a dome above the swirl plates, a hopper below the tank for receiving the refuse solids, a diaphragm deposited between the hopper and the tank, said diaphragm swirl plates and dome defining water discharge openings, an opening for the passage therethrough of refuse solids from the tank to the hopper, an outlet in the hopper for the withdrawal of refuse solids admixed with water, and a launder at the top of the tank for the withdrawal of coal fines admixed with water.

2. In apparatus for recovering coal by gravity separation, the improvement comprising a tank for separating refuse solids from coal fines, a feed well positioned in the tank for feeding a mixture of coal fines and refuse solids into the tank, a gyrating device having a central water inlet, said device being located in the lower portion of the tank for feeding water into the lowermost portion of the tank in a swirling movement, a plurality of spaced and curved swirl plates radiating outwardly from said water inlet, a dome above the swirl plates, a hopper below the tank for receiving the refuse solids, a diaphragm deposited between the hopper and the tank, said diaphragm swirl plates and dome defining water discharge openings, an opening for the passage therethrough of refuse solids from the tank to the hopper, an outlet in the hopper for the withdrawal of refuse solids admixed

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with water, said diaphragm being dome shaped around its peripheral portion to help direct the refuse solids toward the periphery of the lower part of the tank and of the upper part of the hopper, and a launder at the top of the tank for the withdrawal of coal fines admixed with water.

3. In apparatus for recovering coal by gravity separation, the improvement comprising a tank for separating refuse solids from coal fines, a feed well positioned in the tank for feeding a mixture of coal fines and refuse solids into the tank, a gyrating device having a central water inlet, said device being located in the lower portion of the tank for feeding water into the lowermost portion of the tank in a swirling movement, a plurality of spaced and curved swirl plates radiating outwardly from said water inlet, a dome above the swirl plates, a hopper below the tank for receiving the refuse solids, a diaphragm deposited between the hopper and the tank, said diaphragm, swirl plates and dome defining water discharge openings, an opening for the passage therethrough of refuse solids from the tank to the hopper, said opening for refuse solids comprising an annular opening extending around the peripheral portion of the diaphragm, an outlet in the hopper for the withdrawal of refuse solids admixed with water, and a launder at the top of the tank for the withdrawal of coal fines admixed with water.

4. In apparatus for recovering coal by gravity separation, the improvement comprising a tank for separating

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refuse solids from coal fines, a feed well positioned in the tank for feeding a mixture of coal fines and refuse solids into the tank, a gyrating device having a central water inlet, said device being located in the lower portion of the tank for feeding water into the lowermost portion of the tank in a swirling movement, a plurality of spaced and curved swirl plates radiating outwardly from said water inlet, a dome above the swirl plates, a hopper below the tank for receiving the refuse solids, a diaphragm deposited between the hopper and the tank, said diaphragm, swirl plates and dome defining water discharge openings, an opening for the passage therethrough of refuse solids from the tank to the hopper, said opening for refuse solids comprising an annular opening extending around the peripheral portion of the diaphragm, an outlet in the hopper for the withdrawal of refuse solids admixed with water, said diaphragm being dome shaped around its peripheral portion to help direct the refuse solids toward the periphery of the lower part of the tank and of the upper part of the hopper, and a launder at the top of the tank for the withdrawal of coal fines admixed with water.

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