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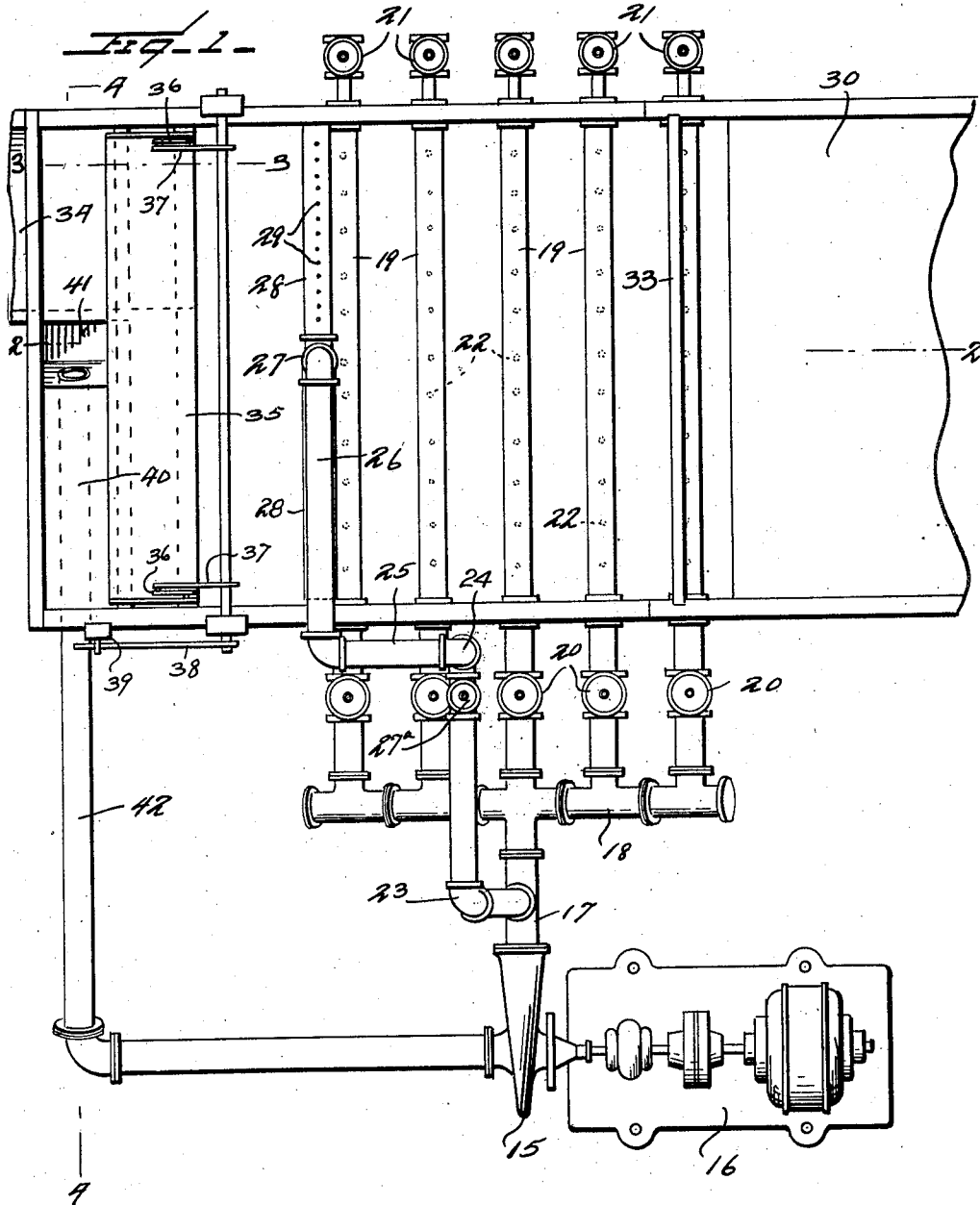
H. H. CARL ET AL

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HYDRAULIC SEPARATOR

Filed Nov. 26, 1927

3 Sheets-Sheet 1



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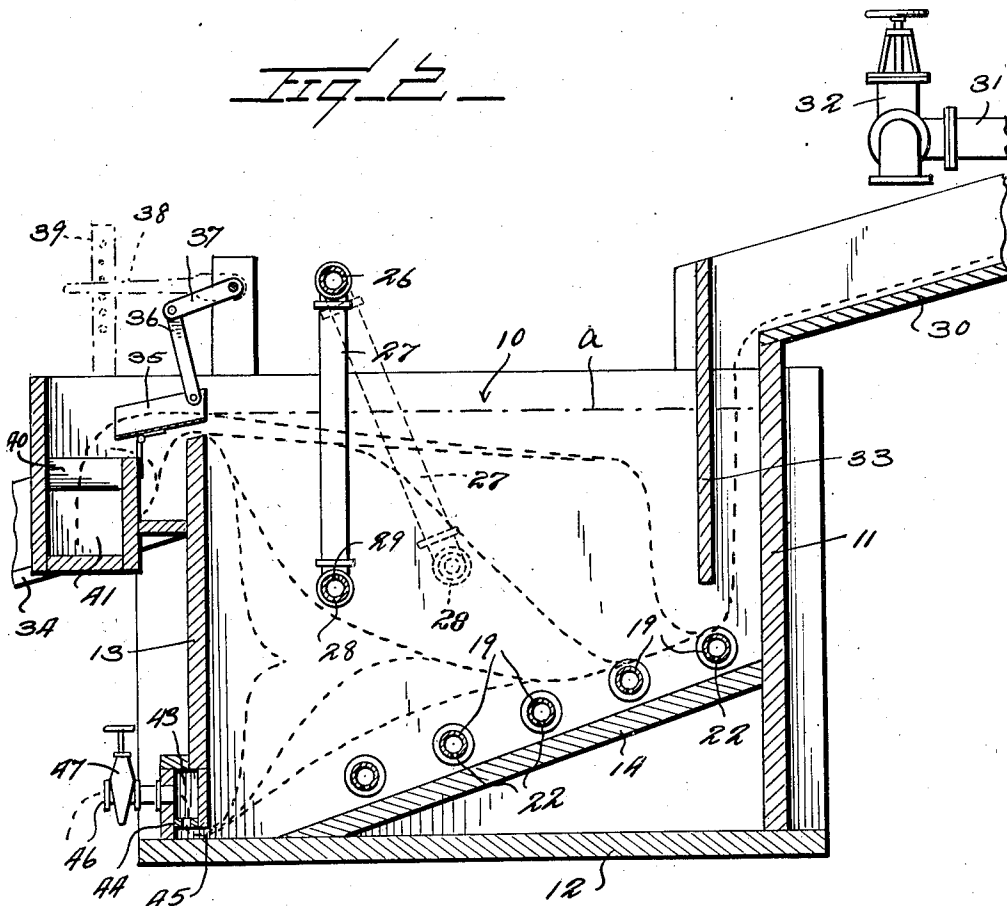
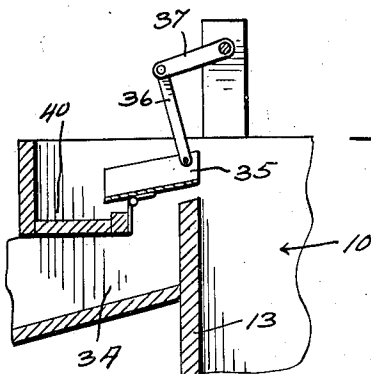
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HYDRAULIC SEPARATOR

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3 Sheets-Sheet 2



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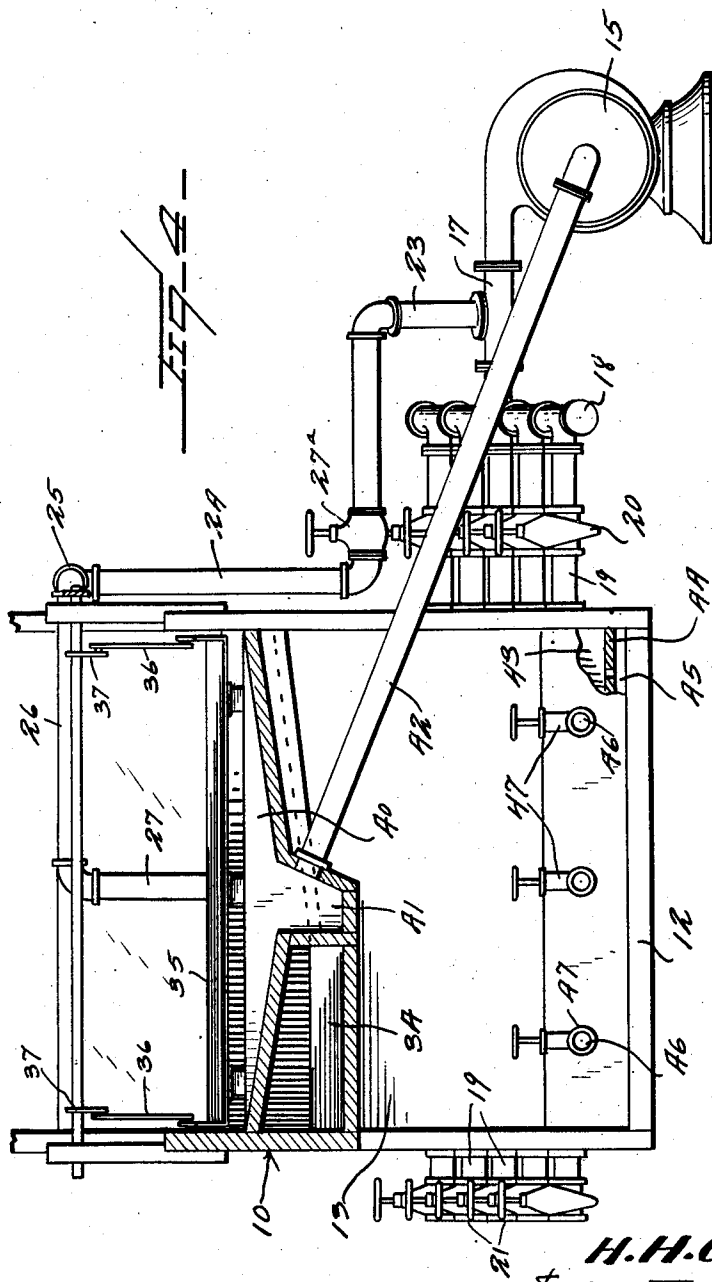
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HYDRAULIC SEPARATOR

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3 Sheets-Sheet 3



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HYDRAULIC SEPARATOR.

Application filed November 26, 1927. Serial No. 235,950.

This invention relates to hydraulic separators, and particularly separators for the purpose of separating coal and similar material from impurities by means of water.

5 The general object of the present invention is to provide an apparatus of this character which is simply and economically constructed and by which coal or similar materials, particularly the smaller sizes thereof, as for instance particles from one-half an inch to very fine powder, may be separated in an efficient manner at a minimum cost.

15 A further object is to provide a construction of this character in which the fine coal or other material to be separated is discharged into a separating tank having therein constantly circulating water, this water overflowing at one end and the material being submitted to the action of currents of water in such manner as to carry upward the relatively light particles of coal, while the heavy particles of slate, rock, etc., sink to the bottom of the tank and are discharged through suitable gates for this purpose.

25 A still further object is to provide means whereby some of the water in the upper portion of the tank may be carried off to feed the pump which pumps water into the feed pipes of the tank so as to increase the density of the mixture within the tank thus increasing the specific gravity of the liquid in the tank and increasing its flotative power, that is its power to carry upward particles of coal which would otherwise sink to the bottom of the tank.

35 A further object in this connection is to provide means to carry off the larger particles of coal but return a certain portion of the water with a definite and appreciable quantity of the very fine coal particles to the circulating pump and back into the tank again, thereby thickening and keeping up the density of the mixture in the tank and thus increasing the specific gravity of the mixture in the tank so as to increase its flotation qualities and secure an increased yield or an increased saving of particles of coal which will tend to sink in relatively pure water.

50 Another object in this connection is to provide, for the purpose of directing a certain

amount of the water in the tank back to the pump, a skimming pan adjustable vertically so as to receive water from the surface of the water in the tank to an amount depending upon the adjustment of the pan, this pan being vertically adjustable to control the amount of water and the amount and size of the fine coal particles delivered to the pump.

Other objects will appear in the course of the following description.

Our invention is illustrated in the accompanying drawings, wherein:—

Figure 1 is a top plan view of a separator constructed in accordance with our invention;

Figure 2 is a vertical sectional view thereof on the line 2—2 of Figure 1;

Figure 3 is a fragmentary section on the line 3—3 of Figure 1;

Figure 4 is a section on the line 4—4 of Figure 1.

Referring to these drawings, 10 designates a tank which is illustrated as being made of wood but may be made of any other suitable material, this tank having a rear wall 11 and a bottom wall 12 and the front wall 13. Disposed within the tank is a downwardly and forwardly extending front or false bottom 14 extending from the wall 11 downward toward the lower end of the wall 13 but terminating short thereof.

Disposed exteriorly to the tank is a circulating pump, which is designated generally 15, and may be of any suitable character, this pump being driven by a motor also of any suitable character and designated 16. The pump discharges through a pipe 17 into a header 18. Extending from this header into the tank are a plurality of pipes 19, each of these pipes being controlled by a valve exterior to the tank and each pipe extending entirely through the tank and at its outer end being provided with a valve 21. The pipes 19 within the tank are provided with perforations 22 which preferably discharge downward and toward the front 14, though we do not wish to be limited to this, as these pipes may be adjusted around their axes so as to discharge in any desired direction.

Extending from the pipe 17 is a branch pipe 23 which extends toward the tank 10 and then extends upward, as at 24, and forwardly,

as at 25, and then transversely, as at 26, again downwardly, as at 27, and then again extends laterally, as at 28, this lateral branch being provided with perforations 29. The joints of this pipe are flexible so that the perforated section 28 may be raised or lowered or turned into any desired angular position and the perforations 29, by turning the pipe 28 to the desired amount, may be either caused to discharge downwardly or upwardly, though ordinarily they discharge upwardly.

The feed, in this instance small coal mixed with dirt, slate, etc., is discharged into the tank by means of the feed trough 30 which has a width equal to that of the tank. Water is also discharged into this trough through the pipe 31 provided with a regulating valve 32. Immediately in advance of the wall 11 but spaced therefrom is the downwardly extending baffle wall 33 which extends down nearly to the series of pipes 22. Thus the material fed into the tank 10 is forced downward below the water level α normally kept in the tank and brought into close proximity to the series of perforated pipes 22. The pipes preferably discharge downward against the inclined bottom 14 and this deflects the water so that upwardly rising currents are formed and the material passing the baffle wall 33 is immediately acted upon by these currents, the lighter material being carried directly up to the upper portion of the water in the tank and then carried toward the outlet end, the slightly heavier material moving downward and then being caught up by the next uprising current of water, and so on so that all the lighter particles are eventually carried up to the outlet of the tank. The water carrying these lighter particles passes over the upper end of the wall 13 and passes into the discharge chute 34.

For the purpose of causing a certain amount of water from the tank to pass back to the circulating pump, we provide at the outlet end of the tank a pan 35, the forward end of which is hingedly supported and the rear end of which is vertically movable by means of the link 36, the crank 37 and the handle 38. This handle 38 is held in any adjusted position by means of pins passing through the upright 39. Any other suitable means for this purpose may be used, however. The skimming pan 35 which, constitutes a chute, discharges into a somewhat hopper-shaped trough 40 disposed just below the pan and extending transversely from one side wall of the tank to the other. This trough at its middle discharges into a sump 41 and from this sump leads the suction pipe 42 of the pump. This sump is provided with an overflow discharge, which overflow discharges into the discharge trough 34.

The forward wall 13 does not extend down to the bottom of the tank but at the bottom of the tank a chamber is formed, designated 43,

the rear wall of which is formed by a transverse wall 44 spaced from the floor 12. Inlet to the chamber is through the openings 45 in the bottom of the chamber and from this chamber lead a plurality of outlets 46 controlled by valves 47. When impurities are deposited around the refuse chamber, then by opening the valves 47 the impurities or heavier particles may be drawn away at this point. The withdrawal of the particles which have collected around or in the refuse chamber also causes a draft of heavier particles from a distance from the chamber toward the chamber and thus all the refuse particles will be drawn out through these valves 47 when the valves are opened. The movable pan or chute 35 acts to keep the bigger particles out of the circulating pump 15, as this pan 35 dips into the overflow just deep enough to supply the pump with the proper amount of water. Only the water from the top is taken off and thus only the smaller and lighter particles of material are carried back to the circulating pump through the suction pipe 42. By doing this there is no danger of the larger material getting into the circulating pump but this larger material is carried directly off through the discharge trough 34 but at the same time the very finely divided particles of material are carried back into the circulating pump and thereby back into the tank, thereby keeping up the discharge of mixture in the tank.

We have found in the actual use of this construction that when starting, and the tank is filled with relatively clear water and finely powdered coal is discharged into the rear end of the tank, that the water does not have sufficient density to lift the larger of these fine particles and that it is only as the density is increased by the return of the very finely powdered coal and water skimmed from the surface of the water in the tank that the water has sufficient flotative power to lift these particles of coal which would otherwise sink to the bottom. By returning these fine particles, therefore, and increasing the specific gravity of the mixture in the tank thereby, we succeed in saving a large amount of fine coal of a relatively valuable size which could not otherwise be saved. When the water in the tank is not of sufficient density to carry up all this coal the skimming chute 35 is dropped slightly so as to carry off a greater amount of the water with the fine coal to the pump, but it is necessary that the skimming chute shall not dip too deeply into the tank as otherwise relatively large particles of coal would be carried off into the pump which is obviously not desirable, both from the standpoint of the pump operation and because it is these larger sizes of coal particles which it is desired to save.

The pipe formed by the members 24, 25, 26, 27 and 28 constitutes a "booster" pipe located

in the front part of the tank and, as before stated, this pipe is movable so that it may be raised or lowered or shifted forward or rearward. This booster pipe, as described, is connected to the circulating pump and the pressure of the mixture being pumped through this booster pipe is controlled by a valve 27^a. This additional agitating pipe or booster pipe is located in the front or deepest part of the tank. By properly adjusting this pipe and regulating the pressure of the mixture pumped through it, a lifting force is created in the tank toward the overflow and, as this force can be regulated, the conditions may be controlled to suit any character of material to be separated. This gives the apparatus a wide range of separating qualities as to different specific gravity and the size of various materials to be cleaned.

We have stated above that when starting up with clear water the larger particles of coal tend to sink. This is avoided in our apparatus by opening the valve controlling the flow of water from the "booster" pipe 28. By increasing the pressure in this pipe an additional lifting force is given to the water and this carries the larger particles of coal upward and then as the density of the water increases the pressure in the pipe 28 is reduced, but practice with our machine has shown us that the "booster" pipe alone is not entirely successful but that it is necessary to increase the density of the water in the tank.

The "booster" pipe is of further value in the operation of this separator because we have found in every separator in which there is a tank with upward and forward discharge of water, there is a "dead spot" as it may be termed, caused by eddy currents wherein the particles of coal simply circulate round and round and become "hung". This "dead spot" varies with different sizes and different forms of tanks, and we have designed the "booster" pipe 28 so that it may be adjusted, by reason of its joints, to any desired position within the tank and thus to any "dead spot" that may arise. This prevents a circular current at this particular point, breaks it up and carries the coal, which would normally hang at this point, upward and forward over the top edge of the front wall. We therefore regard this "booster" pipe as being very important, particularly as it is adjustable to suit all circumstances which may arise during the course of operation. We also regard as important that the pipes 19 shall be rotatably adjustable so that the openings 22 may be directed downward and forward at a proper angle to prevent the sludge from piling up between the pipes.

It will be seen that with this tank the water does not overflow and leave the solid matters behind but by the use of the chute or pan 35 part of the overflow is taken off and sent back to the circulating pump. It will

be noted that the agitation pipes 19 are disposed at an angle to the horizontal and parallel to the pitched floor or false bottom 14. Thus the rearmost pipe is disposed higher up in the tank than each succeeding one and the mixed feed of water, dirt, slate and coal as it strikes the first or highest agitation pipe under the baffle wall is broken up and the lightest materials sent to the top of the tank. Thus the lightest material never gets to the deepest part of the tank nor to the refuse chamber. This, of course, will give each succeeding pipe less material to work on. The heaviest material of all, such as stone, slate, etc., is discharged downward to the bottom of the tank at the lowest part thereof and passes into the refuse chamber. The coal or like material which is lighter than the impurities passes upward with the current through the mixture and is carried to the top of the tank and then over the overflows, while the impurities, which are heaviest, sink to the bottom of the tank in front where there is no agitation. By pumping the mixture which is taken from the chute 35 back through the openings in the agitation pipes keeps the mixed feed as it passes under the baffle 33 agitated and thus keeps the heavy refuse solids from settling in the tank except at the front part, which has no agitation.

The valves 21 are provided in the agitation pipes for the purpose of testing these pipes or cleaning them out.

In the actual use of this apparatus, it has been found that a substantial reduction in the cost of operation is effected and that a more complete separation of coal from impurities and a greater recovery is effected than has heretofore been found possible. At the same time this separation is secured at a minimum cost and expense and a better separation is effected than with other mechanisms known to us. It will be understood that the apparatus can be changed in proportions, sizes, etc., so as to wash and separate larger materials and that such a change in the construction is within the scope of the invention without departing from the spirit of the appended claims.

We claim:—

1. A separator including a tank adapted to contain liquid and having a discharge opening for relatively heavy matter at the forward end of the tank adjacent the bottom thereof and having an opening for the discharge of liquid and relatively light particles of matter suspended therein adjacent the top of the tank at the forward end thereof, means for feeding material mixed with liquid into the end of the tank opposite the discharge, means for forming upwardly and forwardly constantly flowing currents within the liquid in the tank including a pump having an intake pipe, and means for taking liquid and very fine particles in suspension from the top of the liquid in the tank including a skimming

chute disposed above the level of the bottom of the second named discharge opening but below the level of the liquid in the tank, said chute discharging into the intake pipe of the pump and the chute being vertically adjustable to thereby control the amount of water conducted to the intake pipe and definitely control the amount of very fine particles carried to the pump for recirculation.

2. A separator including a tank for containing liquid and having a front wall whose upper edge is below the normal level of the liquid to provide for the discharge of liquid and floating particles over the front wall, the tank adjacent the bottom thereof having an opening for the discharge of relatively heavy refuse matter, means for feeding the material to be separated and liquid into the tank at the rear end thereof, means for causing constantly flowing upwardly and forwardly directed currents in the liquid in the tank including a pump, and a chute having a length equal to the length of the front wall and disposed above the upper edge of the front wall but below the surface of the water discharging over the front wall whereby to skim off said surface water and the lightest particles of material held in suspension therein, and means for delivering the water and particles as discharged directly back into the pump, from thence into the tank to thereby definitely increase the density of the liquid in the tank.

3. In a separator, a tank adapted to contain liquid, and having a discharge at the forward end of the tank adjacent the top thereof, means disposed adjacent the bottom of the tank for causing upwardly and forwardly directed constantly flowing currents in the liquid in the tank, and a booster pipe disposed within the tank above the said means and below the surface of the liquid, the pipe being perforated uniformly along its length and connected to a source of liquid under pressure, said booster pipe acting to discharge upwardly flowing jets of water into the body of water in the tank to prevent "dead" areas in the liquid in the tank.

4. In a separator, a tank adapted to contain liquid, and having a discharge at the forward end of the tank adjacent the top thereof, means disposed adjacent the bottom of the tank for causing upwardly and forwardly directed constantly flowing current in the liquid in the tank, and a pipe disposed within the tank above the bottom thereof and below the surface of the liquid, the pipe being perforated and connected to a source of liquid under pressure, said pipe being formed of a plurality of relatively adjustable sections whereby it may be disposed in various positions within the tank.

5. In a separator, a tank having forward and rear walls and adapted to contain liquid, the forward wall of the tank being formed to permit the liquid to overflow, the forward

wall at its lower end having a refuse discharge opening, perforated pipes disposed at the bottom of the tank, a pump connected thereto, means for discharging material to be separated into the tank, and an adjustable transversely extending perforated valve controlled pipe disposed between the series of first named perforated pipes and the surface of the water in the tank and adjustable into a plurality of different positions in the space between said first named pipes and the surface of the water, said last named pipe being also connected to said pump and receiving water therefrom and acting to assist the first named pipes in forming upwardly and forwardly directed currents.

6. A method of separating relatively light materials suspended in water with relatively heavy materials, consisting in discharging such materials into a tank filled with water, causing the formation of upwardly and forwardly directed currents in the water in the tank, to thereby lift the relatively lighter materials to carry them off from the upper portion of the tank and allow the relatively heavier materials to sink to the bottom thereof and causing an increase in the density of the water contained within the tank by skimming off the surface water and the finest particles carried in suspension thereby from the water in the tank and returning such water with an appreciable and definite quantity of the fine particles in suspension therein to the tank, sufficient to materially increase the density of the water in the tank and increase its specific gravity.

7. A separator including a tank adapted to contain liquid and having a front wall formed to provide a discharge opening whose edge is below the normal level of the liquid to provide for the discharge of liquid and floating particles of coal from the tank, said wall having a refuse discharge opening at the bottom of the tank, means for feeding material and liquid into the tank, a plurality of perforated pipes disposed adjacent the bottom of the tank and causing upwardly and forwardly, constantly flowing currents in the liquid in the tank, a pump connected to and forcing water into said pipes, and means at the discharge opening of the tank for separating the surface water passing through said discharge opening from the remainder of the water passing therethrough and carrying the surface water so separated and containing an appreciable quantity of particles in suspension back to the pump to thereby increase the density of water in the tank.

8. In a separator of the character described, a tank adapted to contain liquid and having a front wall over which the liquid discharges and having a bottom wall, means for discharging material to be separated and a liquid into the rear end of the tank, and means for causing upwardly and forwardly directed

currents to be formed in the liquid in the tank comprising a plurality of pipes disposed adjacent the bottom of the tank, the pipes having perforations extending in a line along one
5 portion of the pipe, the pipes being rotatable upon their axes whereby the jets projected from the perforations may be directed up-

ward at any desired angle in a vertical plane or downward at any desired angle and against the bottom of the tank.

In testimony whereof we hereunto affix our
10 signatures.

HARRY H. CARL.
HENRY E. MUEHLHOF.