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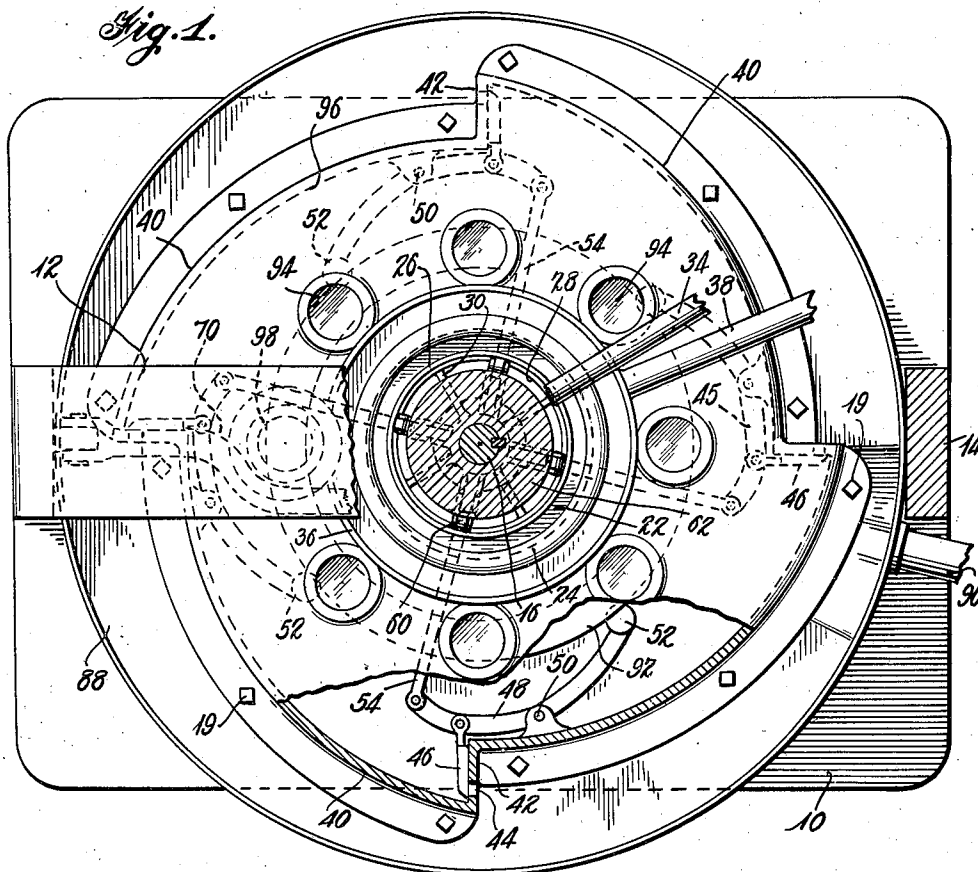
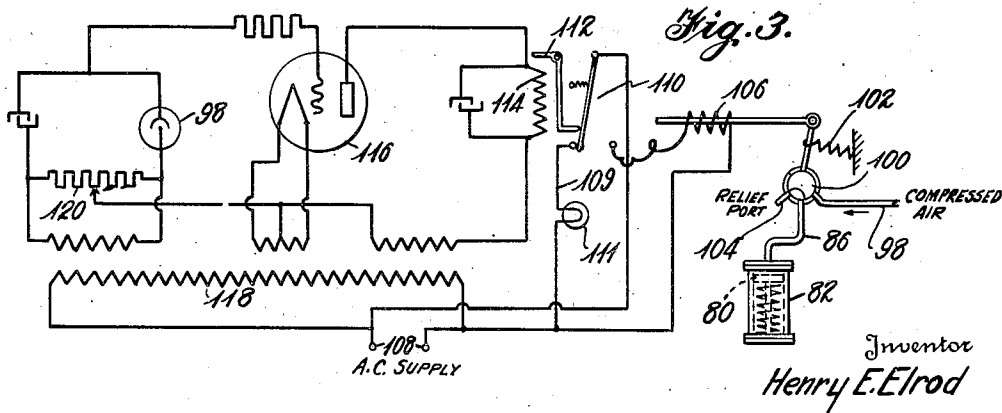
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2,113,175

CENTRIFUGAL SEPARATOR

Filed Aug. 13, 1935

2 Sheets-Sheet 1



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Fig

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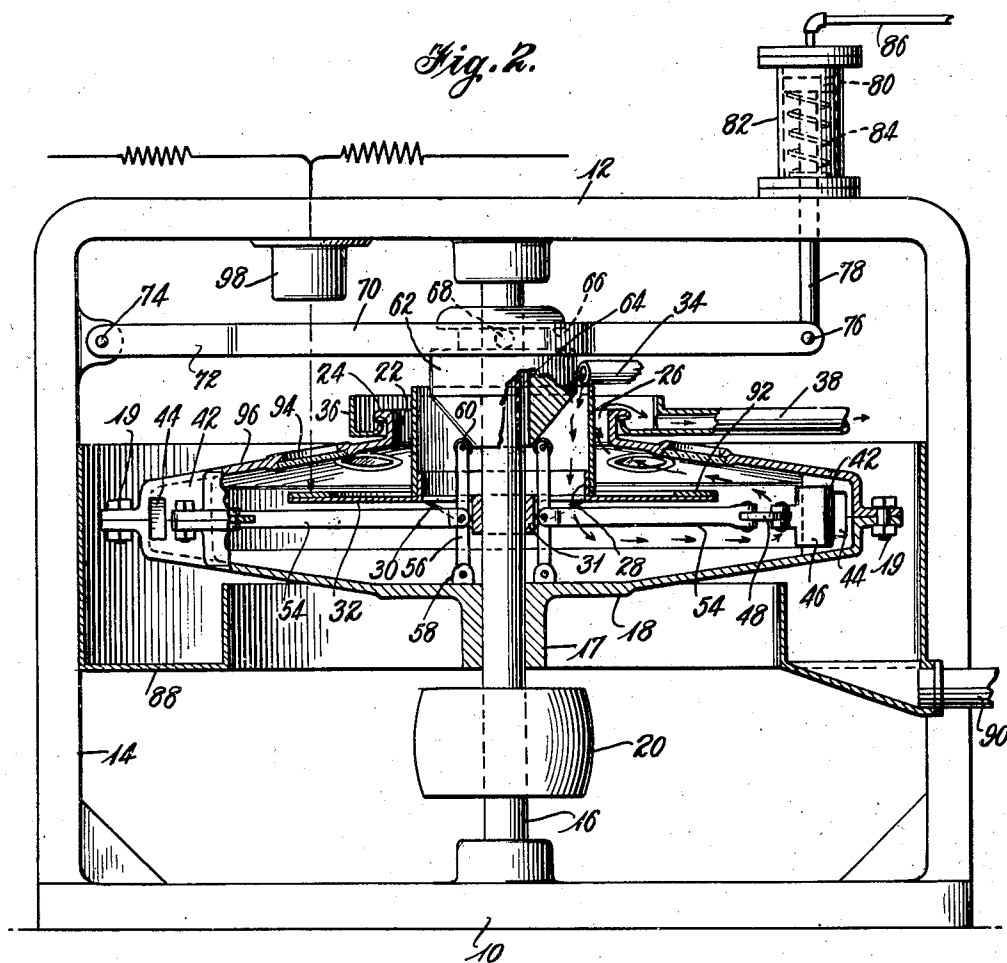
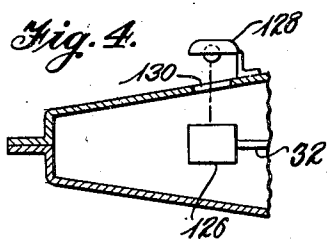
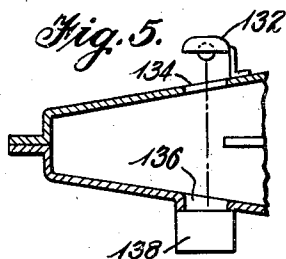
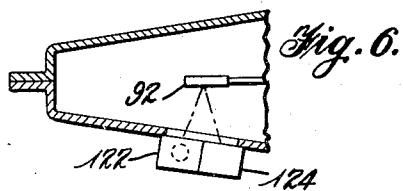
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CENTRIFUGAL SEPARATOR

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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CENTRIFUGAL SEPARATOR

Henry E. Elrod, Houston, Tex.

Application August 13, 1935, Serial No. 36,025

5 Claims. (Cl. 233—20)

This invention relates to improvements in centrifugal separators and its principal object is to provide a machine of this kind which will operate successfully upon mixtures in which the ratio of lighter to heavier substance varies considerably.

My invention is intended for centrifugal separators for treating mixtures in which there is a substantial difference in opacity between the light substance and the heavy substance. Mixtures of solid and liquid, such as wet sludge, are typical examples of the kind of materials for which separators according to my invention are suited.

The essential novel feature of my invention is the use of a light responsive device arranged to sense the transition zone between the lighter and heavier substances, whereby when the accretion of the heavier substance reaches a certain limit, outlet means for the heavier substance can be operated, preferably under the direct control of the light responsive means, to discharge some of the heavier substance. The machine can be arranged to regulate the outlet means to hold the transition zone nearly stationary; or to operate the outlet means intermittently, rapidly discharging a considerable amount of the heavier substance and then allowing it to build up again.

The invention can be embodied in many different forms, some of which are shown in the accompanying drawings, wherein:

Figure 1 is a plan view partly in section of a centrifugal separator according to the invention,

Figure 2 is a vertical section of the same separator taken substantially upon a plane passing through the axis of the separator, parts being however shown in elevation which would actually be cut by the plane,

Figure 3 is a wiring diagram, and

Figures 4, 5, and 6 are fragmentary sectional views of a portion of the separator bowl showing various arrangements of the optical control means.

In the form of the invention shown in Figures 1-3, there is mounted between a base plate 10 and the cross piece 12 of an upright frame 14 a shaft 16 to which is fixed by a hub 17 a separator bowl 18. This bowl is shown as having a greater diametrical than axial extension and this is the preferred shape of bowl for the purpose of the invention. The shaft and bowl can be spun by means of a pulley 20 driven by a belt (not shown). The bowl may conveniently be made in two flanged halves secured together by bolts 19.

At its upper side, the separator bowl 18 has a

central opening 22 formed by a curved-over flange 24. Within the opening 22 is a sleeve 26 secured by a flange 28 to a spider 30, which is fixed by a hub 31 to shaft 16. Extending outward from the spider 30 is a diaphragm 32, which may be in the form of a solid or perforated plate or may consist of radiating arms. The material to be separated is supplied through a pipe 34 to the space within sleeve 26 and pours down through this sleeve into the bottom of the bowl, whence it travels out under the diaphragm 32 toward the periphery of the bowl and there deposits the heavier material, the lighter liquid flowing inward over the top of the diaphragm 32 and out through the opening 22. As the lighter liquid is discharged from the lip 24 it is caught by a trough 36 and led off through an outlet 38.

Means are provided to discharge the heavier material from the periphery of the bowl. In the machine shown in these figures, the periphery of the bowl is in the shape of four eccentric curves 40 connected by radial steps 42. In these radial steps are discharge openings 44 normally covered by gates 46. The gates may be mounted upon weighted arms 48 pivotally connected to the casing of the bowl at 50 and bearing at the end on the far side of the pivot from the gate a weight 52. The opposite end of each lever 48 is connected by a link 54 to the middle of a lever 56, the lower end of which is pivotally connected to the bottom of the bowl at 58 and the upper end of which carries a roller 60 bearing against a cone 62. The cone 62 is connected by a spline 64 to shaft 16 so as to be slidable thereon. A groove 66 in cone 62 is engaged by a roller 68 mounted upon a lever 72 pivoted at 74 to the frame 14. The opposite end of lever 72 is articulated at 76 to the connecting rod 78 of a piston 80 sliding in a cylinder 82 mounted upon the cross bar 12. The piston 80 is normally held in top position by a spring 84 and is forced downward by compressed air admitted to the cylinder 82 by a pipe 86 under the control of means presently to be described.

When the separator is rotating, the weighted levers 48 attached to the gates 46 tend to swing clockwise, under the influence of weights 52, to withdraw the gates 46 from discharge openings 44. The levers are restrained by the action of the cone 62 upon levers 56 and links 54 when the cone is in its lower position, but when the cone is raised to the position shown in Figure 2, the levers 56 are allowed to swing inward under the influence of the weights 52 and open the gates. There are four of the gates 46 and their appur-

tenant control devices and when they are all opened together, the solids which have collected in the periphery of the bowl are discharged into a trough 88 and drain off through an outlet 90.

According to the preferred form of the invention the gates 46 are to be directly controlled by light sensitive means arranged to sense the position of the transition zone between the heavier material accumulating in the periphery of the bowl and the lighter liquid. Figures 1-3 show one arrangement of such control means. There is mounted upon the diaphragm 32 a ring shaped reflector 92, which faces a group of windows 94 arranged in a circle in the upper wall 96 of the separator bowl. Opposite the ring of windows 94, there is mounted upon the cross bar 12 of the frame 14 a light sensitive cell 98, such as a phototube. This tube is influenced by light reflected from the reflector 92 through the windows 94 and is adjusted to change the condition in a control circuit when the fluid passing over the reflector 92 becomes murky, indicating that the transition zone between the heavier material deposited in the periphery of the separator bowl is encroaching upon the reflector.

As shown in Fig. 3, the piston 80 is operated by compressed air supplied from a pipe 98 under the control of a valve 100. This valve is normally held by a spring 102 in position to connect the space above piston 80 in cylinder 82 with relief port 104 open to the atmosphere. The valve is moved by a solenoid 106 to position to close the relief port and connect the cylinder 82 with the compressed air supply. The solenoid 106 is connected to a supply of alternating current 108 by a switch 110 controlled by a relay 112, 114. The coil 114 of the relay is connected in the plate circuit of an amplifier tube 116, in the grid circuit of which is the phototube 98. A transformer 118 supplies the current which maintains the voltage in the several circuits of the amplifier tube 116. A potentiometer 120 permits adjustment of the normal grid voltage to adapt the control circuit to the range of intensity of the light beam striking the phototube 98.

When the light striking the phototube 98 is reduced by the reflector 92 being covered by the heavier material, the voltage drop across the phototube is increased and the grid voltage of tube 116 is made more negative, thus reducing the plate current. This permits the relay 112 and switch 110 to assume the position shown in Fig. 3, thus opening the circuit of solenoid 106 and allowing the valve 100 to swing to the position shown. The air in cylinder 82 is exhausted to the atmosphere and piston 80 rises, raising the cone 62. The levers 56 are allowed to swing inward under the influence of weighted levers 48, which opens the gates 46. In the position shown in Fig. 3 switch 110 may close a circuit 109 containing an alarm or indicating device such as electric lamp 111. When enough of the heavier material has been discharged through the gates to uncover the reflector 92, the beam of light striking phototube 98 reduces the voltage drop across the phototube and makes the voltage of the grid less negative. This increases the plate current and causes the relay 112, 114 to close switch 110, operating solenoid 106 and throwing valve 100 to position to connect the compressed air supply to cylinder 82. The piston 80 is forced down and presses cone 62 downward, thrusting levers 56 outward and closing the gates 46.

An artificial source of light may be provided

to project the light beam which is reflected from reflector 92 to phototube 98. In this case the phototube and source of light may both be mounted directly on the separator bowl, as shown in Fig. 6. In this figure the source of light is indicated at 122 and phototube at 124. These being mounted on the bottom wall of the separator bowl, reflector 92 faces downward. The light source and phototube can be connected through collector rings (not shown) with the control circuits.

The reflector can be dispensed with in the form of invention shown in Fig. 4. In this case, a phototube 126 is mounted upon diaphragm 32 and a source of light 128 shines through a window 130 upon the phototube.

Fig. 5 shows still another modification wherein the reflector is again dispensed with by making the light beam travel from a source of light 132 through a window 134 across the critical zone of the separator bowl, through a window 136 to phototube 138. In all these cases the heavier solids building up in the periphery of the separator bowl interrupt the beam of light and therefore increase the voltage drop across the phototube.

The invention is susceptible of many modifications, the forms shown being merely illustrative.

Having described my invention, I claim:

1. In a centrifugal separator, a rotary bowl, a reflector mounted in said bowl between the axis and the periphery thereof, window means in the wall of said bowl for admitting light to said reflector, light responsive means facing said reflector through said window means, means for guiding the mixture to be separated into said bowl behind said reflector, variable outlet means for the heavier substance, and means whereby said outlet means is operated under the control of said light responsive means to release the heavier substance when said reflector is obscured thereby.

2. In a centrifugal separator, a rotary bowl of greater diametrical than axial extension, window means in the wall of said bowl within a zone between the axis and the periphery of said bowl, means for sensing through said window means the position of the transition zone between the lighter and heavier materials being separated, and discharge means for the heavier materials controlled by said sensing means.

3. In a centrifugal separator, a rotary bowl, normally closed outlet means for discharging the heavier substance from said bowl, reflecting means located within a zone in said bowl which is to be the limit of accretion of the heavier substance, means for illuminating said reflecting means, light responsive means under the influence of light reflected from said reflecting means, and means controlled by said light responsive means for opening said outlet means when said reflector becomes obscured by accretion of the heavier substance.

4. In a centrifugal separator, a rotary bowl having two opposite walls extending outward at a large angle to the axis of the bowl, light responsive means facing one of said walls, means including opposed windows in said walls for transmitting a beam of light through said bowl to said light responsive means across the zone which is to be the limit of accretion of the heavier substance, and outlet means for the heavier substance controlled by said light responsive means.

5. In a centrifugal separator, a rotary bowl, outlet means for the heavier substance adjacent

the periphery of the bowl, means operable during the rotation of the bowl to apply a force tending to open said outlet means, means operable to close said outlet means and to hold the same
5 closed against the action of said force applying means, photosensitive means for sensing the transition zone between the heavier and lighter substance, and means controlled by said photo-

sensitive means to withdraw said closing means when the heavier substance is interposed in the zone of influence of said photosensitive means and to restore said closing means to operative position when the heavier substance passes out
5 of the zone of influence of said photosensitive means.

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