Sept. 4, 1951 R. A. HILL 2,566,662

SAND SEPARATOR

Filed June 14, 1948

Fig. 1.

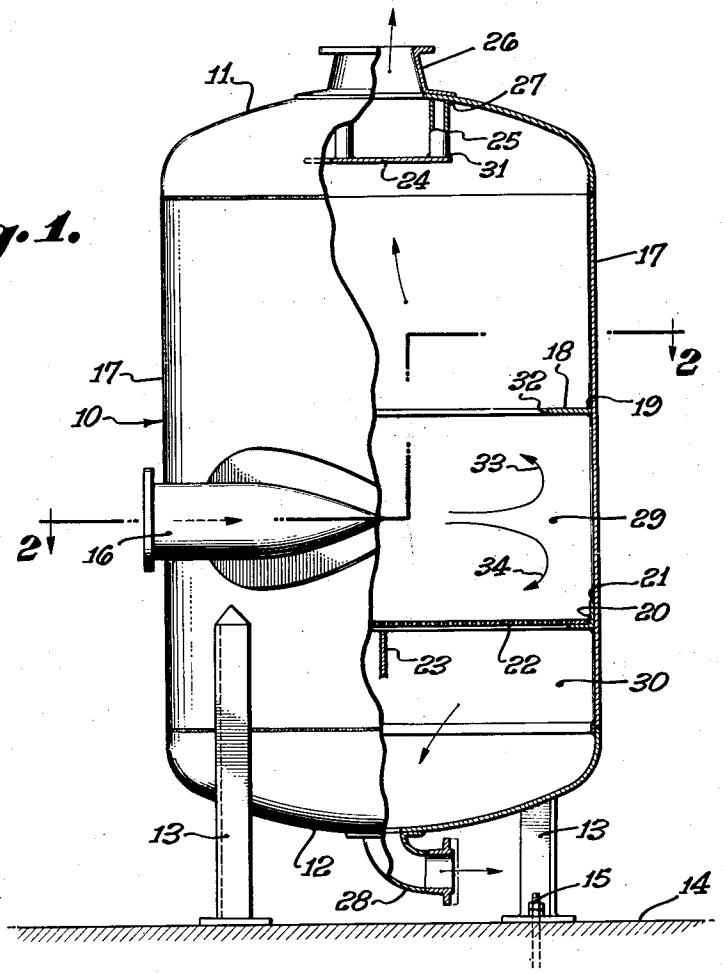
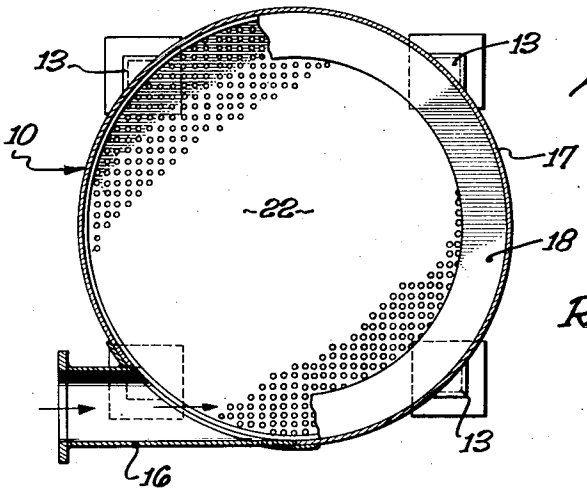


Fig. 2.



RAYMOND A. HILL,
INVENTOR.

BY Hoalwin White

ATTORNEY.

Patented Sept. 4, 1951 2,566,662

UNITED STATES PATENT OFFICE

2,566,662

SAND SEPARATOR

Raymond A. Hill, San Marino, Calif.

Application June 14, 1948, Serial No. 32,877

9 Claims. (Cl. 210—43)

1

This invention relates generally to improved separators for removing solid particles from liquids and particularly to devices especially adapted for the separation of entrained sand from water.

A major object of the present invention is the provision of a separator characterized by maximum simplicity consistent with effective operation. In order to achieve this object, I employ a device in which separation is effected in two successive stages, the larger particles of sand or other entrained material being initially removed by centrifugal force as the water moves rapidly in a rotary path, and the finer particles being subsequently removed by gravity after the rate of water flow has been decreased to a value permitting falling of those particles. Such results are achieved by the use of a closed tubular casing or container and means for introducing a stream of sand-carrying water tangentially into the casing to impart a swirling motion to the water. This swirling motion causes the heavier sand particles to be segregated toward the outer wall of the casing, from which location they are recovered in a bottom settling chamber by the later described gravity effects and courses of deposition resulting from the swirling and rolling paths taken by the water.

The invention is particularly concerned with the provision of a unique arrangement which assures reduction of the water velocity to a value sufficiently low for the finer particles of sand to be separated by gravity. This result is effected by means directing the water inwardly toward the central region of the casing as it loses the initial relatively high velocity. Preferably, a transverse shoulder restricts lateral spreading of the water stream in the direction of the water outlet and thus restricts the water to a predetermined annular path while it remains near the casing wall. Being thus restricted, the water must flow inwardly toward the relatively quiescent central region in which the rate of flow is substantially below the sand entraining velocity, as a consequence of which the finer particles of sand gravitate to the settling chamber.

The present invention provides a sand passing partition effectively dividing the casing interiorly into an upper swirl chamber and a lower settling chamber, the latter of which may contain means inhibiting swirling therein to assure rapid settling of the sand after passing the partition. In addition, means are provided for preventing the formation of a vortex to thereby prevent possible re-entrainment of initially separated sand.

The above and further features and objects of the present invention will be better understood from the following detailed description of a typical embodiment, as illustrated by the accompanying drawing, in which:

2

Fig. 1 is a side elevation of the separator, partly in section to reveal the internal construction; and

Fig. 2 is a cross section through the separator taken on line 2—2 of Fig. 1.

The separator comprises generally a casing 10, including cylindrical side wall 17, rounded top 11 and bottom 12. The casing is suitably supported, as by legs 13, which may be bolted to the floor or other surface 14, as at 15. Inlet pipe 16 directs sand-carrying water tangentially into the cylindrical side wall of the casing. After separation, the water is emitted from outlet 26 in the top of the casing, and the sand passes outwardly through pipe 28 in the bottom.

If the illustrated cylindrical casing were employed without any system of internal baffling, the water would swirl upwardly along the wall of the casing at a velocity equal to or greater than the entrainment velocity with respect to the finer particles. Though some of the entrained particles might be centrifugally separated, a substantial proportion would be carried on by the rapidly moving water, and separation would therefore be incomplete. To assure removal of even the finest sand particles, I provide a novel baffle arrangement of extreme simplicity which effectively reduces the water velocity to a value well below that at which the sand will separate by gravity.

Ring 18 is secured to the inner surface of the casing wall, as by annular weld 19, and projects inwardly to form a transverse shoulder preventing upward movement of water until it has swirled inwardly beyond edge 32 of the ring. Annular L-shaped bracket 20 is secured, as by welding at 21, to the inner surface of the cylindrical casing wall at a location approximately as far below the inlet 16 as is ring 18 above the inlet. Bracket 20 supports circular screen 22, whose openings are of sufficient size to permit downward passage of sand but are small enough to substantially reduce the velocity of any swirling water which may pass through the screen. Thus the screen serves as a partition to divide the casing interiorly into an upper swirl chamber 29 and a lower settling chamber 30. Fin or baffle 23 depends from bracket 20 and extends diametrically across the screen to further inhibit swirling in the lower settling chamber.

Baffle 24 is positioned transversely beneath water outlet 26 by hangers 25 depending from the top of the casing, the baffle and hangers being suitably secured together and to the top, as by welding at 27 and 31. This baffle prevents the formation of a high velocity vortex which might otherwise re-entrain substantial quantities of initially segregated sand and thus materially reduce the efficiency of the separator.

In operation, sand-carrying water enters the

separator through tangential inlet 16, which causes it to swirl in a rotary path against the inner surface of cylindrical casing wall 17. In the initial stages of its passage through the separator, the water is directed in a relatively narrow annular path between ring 18 and screen 22. Being thus confined, it is soon forced inwardly toward the central region of the casing. As it moves inwardly, the water tends to divide into two streams, one moving upwardly as indicated by the arrow 33 and the other rolling downwardly at 34. The largest particles of sand are separated from the water by centrifugal force while it swirls at high velocity, immediately after injection and accumulate along the outer wall of the casing to be carried downwardly by stream 34 and pass through screen 22 into the settling chamber beneath the screen. The finer particles are carried inwardly with the water in stream 33, which rapidly loses velocity as it nears the center of the casing. The central region of the casing is relatively quiescent, the water moving in that area at a rate below the sand entraining velocity to permit finer particles of sand to fall downwardly through the screen into the settling chamber. After separation has thus been effected, the cleaned water rises slowly toward outlet 26, and the sand may be drawn off through pipe 28.

I claim:

1. A separator of the character described, comprising a cylindrical casing, an inlet for introducing a stream of sand-carrying water tangentially into said casing to impart swirling motion thereto, the interior of the casing being empty and unobstructed radially between said inlet and the axial center of the casing an outlet to which the water passes at a relatively slow rate after spiralling inwardly away from the cylindrical wall of said casing, means presenting an annular transverse shoulder extending inwardly from an intermediate location along the casing wall a distance corresponding to a minor portion of the casing radius and retaining said water against movement therebeyond in the direction of said outlet until the water has moved inwardly a predetermined distance from said casing wall, the sand carried into the casing by the water being separated therefrom by centrifugal force and gravity during the passage of the water through the separator, a partition beneath said inlet and said outlet for dividing said casing interiorly into an upper swirl chamber and a lower settling chamber and permitting passage of separated sand downwardly therethrough, a baffle disposed transversely across said settling chamber beneath said partition to inhibit swirling within said settling chamber, and a sand outlet leading from said settling chamber.

2. A separator of the character described, comprising a cylindrical casing, an inlet for introducing a stream of sand-carrying water tangentially into said casing to impart swirling motion thereto, the interior of the casing being empty and unobstructed radially between said inlet and the axial center of the casing an outlet to which the water passes at a relatively slow rate after spiralling inwardly away from the cylindrical wall of said casing, means presenting an annular transverse shoulder extending inwardly from an intermediate location along the casing wall a distance corresponding to a minor portion of the casing radius and retaining said water against movement therebeyond in the direction of said outlet until the water has moved inwardly a predetermined distance from said casing wall, the sand carried into the casing by the water being separated therefrom by centrifugal force and gravity during the passing of the water through the separator, a circular screen extending transversely of said casing beneath said inlet and said outlet for dividing said casing interiorly into an upper swirl chamber and a lower settling chamber, and a sand outlet leading from said lower chamber.

3. A separator of the character described, comprising a cylindrical casing, an inlet for introducing a stream of sand-carrying water tangentially into said casing to impart swirling motion thereto, the interior of the casing being empty and unobstructed radially between said inlet and the axial center of the casing an outlet to which the water passes at a relatively slow rate after spiralling inwardly away from the cylindrical wall of said casing, means presenting an annular transverse shoulder extending inwardly from an intermediate location along the casing wall a distance corresponding to a minor portion of the casing radius and retaining said water against movement therebeyond in the direction of said outlet until the water has moved inwardly a predetermined distance from said casing wall, the sand carried into the casing by the water being separated therefrom by centrifugal force and gravity during the passage of the water through the separator, a partition beneath said inlet and said outlet for dividing said casing interiorly into an upper swirl chamber and a lower settling chamber and permitting passage of separated sand downwardly therethrough, baffie means inhibiting swirling within said settling chamber, and a sand outlet leading from said settling chamber.

4. A separator of the character described, comprising a cylindrical casing, an inlet for introducing a stream of sand-carrying water tangentially into said casing to impart swirling motion thereto, the interior of the casing being empty and unobstructed radially between said inlet and the axial center of the casing, an outlet to which the water passes at a relatively slow rate after spiralling inwardly away from the cylindrical wall of said casing, means presenting an annular transverse shoulder extending inwardly from an intermediate location along the casing wall a distance corresponding to a minor portion of the casing radius and retaining said water against movement therebeyond in the direction of said outlet until the water has moved inwardly a predetermined distance from said casing wall, a baffle plate disposed transversely in front of said water outlet to prevent the formation of a vortex, the sand carried into the casing by the water being separated therefrom by centrifugal force and gravity during the passage of the water through the separator, and an outlet for the sand.

5. A separator of the character described, comprising a vertical cylindrical closed casing, an inlet in the side wall of said casing for introducing a stream of sand carrying water tangentially into said casing to impart a swirling motion thereto, an outlet in the top of said casing to which the water rises at a relatively slow rate after spiralling inwardly away from the cylindrical side wall of said casing, a ring attached to the inner surface of the cylindrical casing wall above said inlet and presenting a horizontal shoulder retaining said water against upward movement therebeyond until the water has moved inwardly from said casing wall past the

inner edge of said ring, a baffle plate disposed transversely beneath said water outlet to prevent the formation of a vortex, a horizontal screen disposed across said casing beneath said inlet and dividing the casing interiorly into an upper swirl chamber and a lower settling chamber, the larger particles of sand carried into the casing by the water being separated by centrifugal force during the initial swirling motion and then falling through the screen into the lower chamber, the smaller particles of sand falling through the screen from the relatively quiescent central region of the casing where the water velocity is relatively low, a baffle extending diametrically across said lower chamber to inhibit swirling therein, and an outlet for the sand from the lower chamber.

6. A separator of the character described, comprising a cylindrical casing, an inlet in the side wall of said casing for introducing a stream of sand-carrying water tangentially into said casing to impart swirling motion thereto, the interior of the casing being empty and unobstructed radially between said inlet and the axial center of the casing, an outlet offset axially of the casing from said inlet and to which the water passes at a relatively slow rate after spiralling inwardly away from the cylindrical wall of said casing, means presenting an annular transverse shoulder extending inwardly from an intermediate location along the case wall a distance corresponding to a minor portion of the casing radius and retaining said water against movement axially therebeyond in the direction of said outlet until the water has moved inwardly a predetermined distance from said casing wall, the water passing space inwardly of the casing from said shoulder being unobstructed to permit unrestricted passage of the water radially inwardly from the inlet to the inner edge of said shoulder and then axially toward said outlet, the sand carried into the casing by the water being separated therefrom by centrifugal force and gravity during the passage of the water through the separator, and an outlet for the sand.

7. A separator of the character described, comprising a cylindrical casing, an inlet in the side wall of said casing for introducing a stream of sand-carrying water tangentially into said casing to impart whirling motion thereto, the interior of the casing being empty and unobstructed radially between said inlet and the axial center of the casing, an outlet offset axially of the casing from said inlet and to which the water passes at a relatively slow rate after spiralling inwardly away from the cylindrical wall of said casing, means presenting an annular transverse shoulder extending inwardly from an intermediate location along the case wall a distance corresponding to a minor portion of the casing radius and retaining said water against movement axially therebeyond in the direction of said outlet until the water has moved inwardly a predetermined distance from said casing wall, the water passing space inwardly of the casing from said shoulder being unobstructed to permit unrestricted passage of the water radially inwardly from the inlet to the inner edge of said shoulder and then axially toward said outlet, the sand carried into the casing by the water being separated therefrom by centrifugal force and gravity during the passage of the water through the separator, a partition beneath said inlet means and said outlet for dividing said casing

interiorly into an upper swirl chamber and a lower settling chamber and permitting passage of separated sand downwardly therethrough, and a sand outlet from said lower chamber.

8. A separator of the character described, comprising a cylindrical casing, an inlet in the side wall of said casing for introducing a stream of sand-carrying water tangentially into said casing to impart swirling motion thereto, the interior of the casing being empty and unobstructed radially between said inlet and the axial center of the casing, an outlet offset axially of the casing from said inlet and to which the water passes at a relatively slow rate after spiralling inwardly away from the cylindrical wall of said casing, a ring attached to the inner surface of the cylindrical casing wall between said inlet and said outlet and presenting a transverse shoulder retaining said water against movement axially therebeyond in the direction of said outlet until the water has moved inwardly a predetermined distance from said casing wall, the radial dimension of said ring being a minor portion of the casing radius, the water passing inwardly of the casing from said shoulder being substantially unobstructed to permit unrestricted passage of the water radially inwardly from the inlet to the inner edge of said shoulder and then axially toward said outlet, the sand carried into the casing by the water being separated therefrom by centrifugal force and gravity during the passage of the water through the separator, and an outlet for the sand.

9. A separator of the character described, comprising a cylindrical casing, inlet means for introducing a stream of sand-carrying water tangentially into said casing to impart swirling motion thereto, the interior of the casing being empty and unobstructed radially between said inlet and the axial center of the casing, an outlet to which the water passes at a relatively slow rate after spiralling inwardly away from the cylindrical wall of said casing, means presenting an annular transverse shoulder extending inwardly from an intermediate location along the case wall a distance corresponding to a minor portion of the casing radius and retaining said water against movement therebeyond in the direction of said outlet until the water has moved inwardly a predetermined distance from said casing wall, the sand carried into the casing by the water being separated therefrom by centrifugal force and gravity during the passage of the water through the separator, a transverse screen beneath said inlet and said outlet for dividing the casing interiorly into an upper swirl chamber and a lower settling chamber and permitting passage of separated sand downwardly therethrough, and a sand outlet in said lower chamber.

RAYMOND A. HILL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,665,081	Andrews	Apr. 3, 1928
1,751,689	Enz et al.	Mar. 25, 1930
1,830,713	Palmer	Nov. 3, 1931
1,919,653	Hill	July 25, 1933
2,425,110	McCurdy	Aug. 5, 1947
2,491,801	Debrey	Dec. 20, 1949