July 19, 1966 N. A. L. WIKDAHL 3,261,467

MULTIPLE CYCLONE ASSEMBLY

Filed Sept. 13, 1961

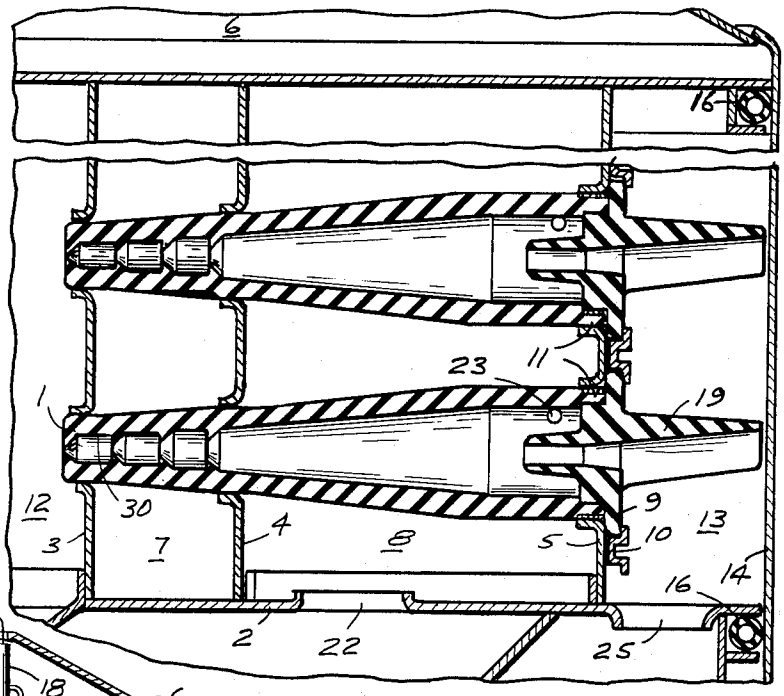

FIG. 3

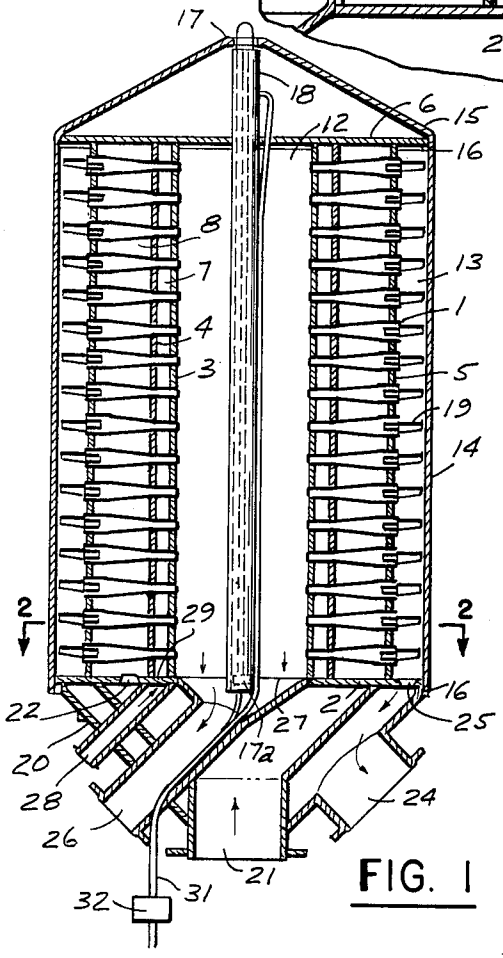

FIG. 1

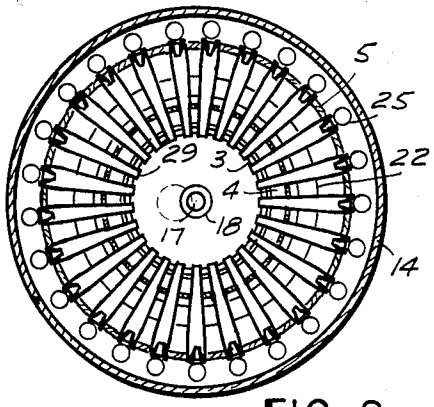

FIG. 2

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United States Patent Office 3,261,467 Patented July 19, 1966

3,261,467

MULTIPLE CYCLONE ASSEMBLY

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Filed Sept. 13, 1961, Ser. No. 137,809
Claims priority, application Sweden, Sept. 22, 1960, 9,041/60
17 Claims. (Cl. 209—211)

The present invention relates to hydro-cyclones and more particularly to a multiple hydro-cyclone assembly, including a plurality of cyclones connected in parallel.

It is known to arrange the cyclones of such assembly in groups or layers in which the longitudinal axes of the cyclones are parallel to each other and perpendicular or inclined in reference to a longitudinal axis of a common mounting block.

It is also known to arrange the cyclones of the assembly in one or several co-axial groups in each of which the respective, usual conical cyclones are disposed in a common plane and radially oriented, the narrow ends of the cyclones facing a common center axis. In that type of assembly the cyclones may be supported by concentrically disposed tubular members which, together with end walls, define separate annular chambers into which the fluid containing the material to be separated is fed and in which the separated material is collected.

The construction and operation of multiple cyclone assemblies of the general kind above referred to involve various constructional and operational problems such as constructing the assembly in a rapid and efficient fashion; inspecting and cleaning the individual cyclones of the assembly; smoothly and uniformly distributing the supply of fluid to be treated among the cyclones, and providing tight seals between the cyclones and the supporting walls of the tubular members.

It is the broad object of the present invention to produce a novel and imroved multiple cyclone assembly which can be rapidly and efficiently constructed, the cyclones of which can be conveniently cleaned and inspected, which can be smoothly and uniformly supplied with the suspension to be separated and in which the cyclones are effectively sealed to supporting walls.

According to the invention, the aforementioned objects, features and advantages and other objects, features and advantages which will be pointed out hereinafter, are obtained by a multiple cyclone assembly comprising a plurality of cyclones stacked in several parallel layers, in each of which the cyclones are radially disposed and face the center axis of the stack at one end, the cyclones being supported by several concentrically disposed tubular members defining together with end walls several separate annular chambers into which the fluid flow containing the material to be separated is fed and in which the separated material is collected, and further comprising an outer tubular casing encompassing the outermost one of said tubular members radially spaced therefrom to define together with said outermost member and the end walls a further annular chamber separated from the aforementioned chambers, said casing being lengthwise movable in reference to said tubular members and the cyclones supported thereby and being sealed against the end walls, preferably by sealing means interposed between the casing and the end walls.

In the accompanying drawing a preferred embodiment of the invention is shown by way of illustration and not by way of limitation.

In the drawing:

FIG. 1 is an elevational, sectional view of a multiple cyclone assembly according to the invention.

FIG. 2 is a section taken on line II—II of FIG. 1, and

FIG. 3 is a fragmentary sectional view showing the top part and the bottom part of FIG. 1 on an enlarged scale.

Referring now to the figures in detail, the hydro-cyclone assembly, as shown, comprises a plurality of parallel layers or groups of generally conical cyclones, 16 groups being shown by way of example. The groups are disposed in superimposed arrangement to form a stack of cyclones. Each of the groups or layers includes a plurality of cyclones, 25 cyclones being shown by way of example in each group. The cyclones are disposed in radial arrangement, the narrow ends of the cyclones facing the common center axis of the stack. The array of cyclones is mounted by means of a base or end wall **2** which supports three cylindrical tubular members **3**, **4** and **5** made of suitable sheet metal. The rim of wall **2** protrudes beyond the periphery of member **5**. The tubular members are closed up at the upper end by an upper end wall **6** of ring shaped configuration. The diameter of wall **6** is also greater than the diameter of the outermost tubular member **5** for a reason which will be more fully explained hereinafter. Members **3**, **4** and **5**, together with walls **2** and **6**, define two annular chambers **7** and **8**. In addition, tubular member **3** defines a central chamber **12**. The three tubular members are formed with holes disposed in transverse or radial alignment, one set of holes being provided for each group or layer of cyclones. The cyclones which are preferably made of rubber or similar material, are inserted in the holes so that the narrow ends of the cyclones communicate with the central chamber **12** and that the wide ends of the cyclones are substantially flush with the outermost tubular member **5**. The wide ends of the cyclones are mounted in member **5** by any suitable means such as a flanged joint **9** made of rubber or other suitable material. Flanged joints **9** may be secured to member **5** by a one-turn screw cap **10** or similar means. The holes through the tubular members are preferably flanged and the cyclones are provided with external threads or collars **11** where they pass through the holes, to effect labyrinth sealings between the cyclones and the tubular members, thus tightly separating chambers **7** and **8** from each other. To locate the cyclones in their correct positions within the holes, the diameters of the holes decrease from the outermost tubular member to the innermost tubular member in accordance with the angle of the conical walls of the cyclones.

The cyclone assembly so far described is encased by a casing **14**. The casing is of circular cross-section between base wall **2** and upper end wall **6** and the inner diameter of the casing corresponds substantially to the diameters of walls **2** and **6**. To effect adequate sealing between the wall of casing **14** and end walls **2** and **6**, elastic tubes **16** made of rubber or other suitable material are interposed between casing **14** and plates **2** and **6**. The sealing tubes may be held in position by cages formed on the plates and are preferably inflated by means of a suitable pressure fluid to maintain the required seal between the casing and the end walls. As is evident, casing **14**, together with tubular member **5** and the protruding marginal portions of walls **2** and **6**, define a further chamber **13**.

Chamber **8** serves to supply the suspension to the cyclones; central chamber **12** to collect heavies separated by the cyclones; chamber **13** to collect fines separated by the cyclones and chamber **7** to supply flushing liquid to the cyclones, as will be more fully explained hereinafter.

Casing **14** is continued above end wall **6** by a closure portion **15** which may have the illustrated conical configuration; it may also be bell-shaped. The closure portion closes the central chamber **12** and supports a lifting means such as a hydraulic lifting means of suitable and conventional design. The lifting means is diagrammatically shown and should be visualized as comprising a cylinder **18** in which is slidable a piston **17***a* mounting a piston-rod **17**. The piston-rod is coupled to the casing

14 at the apex thereof. Accordingly, the casing may be raised in reference to the cyclone assembly when the piston-rod is caused to move upwardly by feeding a pressure fluid into cylinder 18 on the appropriate side of the piston therein; similarly the casing may be lowered by appropriately changing the pressure conditions within the cylinder. Pressure fluid is fed to the lifting means and discharged therefrom through conduits 31. Hydraulic lifting means of this kind are well known in the art and readily understandable. The piston may be a double-acting piston and means may be provided for securing the piston in one or several pre-determined positions. Such means may comprise a conventional control valve 32 included in conduits 31. As is evident, lifting of the casing uncovers the cyclones so that the same are accessible for inspection and servicing. Due to the aforedescribed mounting of the cyclones in graduated openings, the individual cyclones can be readily withdrawn from the assembly and relocated in position.

The suspension to be treated is supplied to the cyclones through openings 23. These openings are tangentially oriented and several circumferentially spaced openings may be provided for each cyclone. The heavies are discharged from the cyclones through outlets at the narrow ends thereof as is customary and the lights are discharged at the wide end of the cyclones. Flanged joints 9 are formed with a discharge funnel 9*a* which is oriented co-axially with the cyclone and protrudes inwardly preferably beyond the location of inlets 23. Joint 9 is outwardly extended to form a deflector 19 downwardly deflecting the lights discharged through joint 9. Deflector 19 terminates very close to the inner wall of casing 14, thus preventing or at least severely limiting, any outward displacement of the cyclones due to axially directed pressures on the cyclones. Each cyclone further includes one or several, preferably tangentially directed openings 30 connecting the end of the cyclones at which the heavies are discharged with chamber 7. Flushing liquid is injected into the cyclones through these openings.

Base wall 2 is formed with ports 22 and 25 and is mounted upon a manifold socket 20 which supports the entire assembly and includes several ducts preferably terminating in flanges for a convenient connection of outside conduits. More specifically, a centrally located duct 21 is connected with ports 22 for supplying the suspension to be treated to chamber 8 from which it is distributed to the cyclones through inlet 23. A duct 24 is connected through ports 25 to chamber 13 for discharging the lights collected in that chamber; a duct 26 is connected through the central opening 27 in the base wall 2 with chamber 12 for discharging the heavies collecting in that chamber; and a duct 28 is connected through a port 29 with chamber 7 for feeding flushing liquid to the cyclones through openings 30. Finally, the manifold 20 also accomodates conduits 31 for supplying pressure fluid to the lifting means and discharging pressure fluid therefrom.

As is evident from the previous description, all the connections to the cyclone assembly are effected through the manifold or socket 20. This arrangement permits an installation of the entire assembly so that the manifold and the conduits connected thereto are disposed in a pit or below floor level so that the only part visible above floor level is the outer casing 14. Such an arrangement permits a convenient servicing of the cyclones after lifting of the casing without any danger to the conduits or other connections.

The central disposition of feed duct 21 and the limited throttling of the flow of the suspension at ports 22 assure a uniform distribution of the supplied suspension among the cyclones of the assembly.

While the invention has been described in detail with respect to a certain now preferred example and embodiment of the invention, it will be understood by those skilled in the art, after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended therefore to cover all such changes and modifications in the appended claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A multiple cyclone assembly for separating material suspended in a fluid suspension, said assembly comprising a plurality of cyclones having a discharge opening at each end and disposed in several layers in stacked arrangement, one discharge end of each of the cyclones in each of said layers facing the center axis of the stack, several nested tubular members of circular cross section disposed in radially spaced coaxial relationship, upper and lower end walls closing said tubular members at each end, said members and said end walls defining several closed annular chambers, said cyclones being supported and located by said tubular members, each of said cyclones having an inlet opening communicating with one of said chambers for supplying a flow of suspension to the cyclones, the other discharge end of each of said cyclones extending through the outermost one of said tubular members, and an axially displaceable casing of circular cross section encompassing the outermost one of said tubular members spaced apart therefrom and forming together with portions of said end walls a further closed annular chamber, said other discharge end of the cyclones discharging into said further chamber, said casing being mounted detached from said tubular members and said end wall portions whereby said casing is axially displaceable with respect thereto, displacement of said casing in reference to said tubular members and end walls rendering the cyclones supported by said members accessible for assembly, disassembly and servicing.

2. An assembly according to claim 1, wherein said end walls peripherally overhang the outermost tubular member to form said end wall portions, and sealing means are interposed between said overhanging portions of the end walls and adjacent side wall portions of the casing to seal said further chamber at the upper and lower end.

3. An assembly, according to claim 1, wherein the innermost tubular member defines a central chamber, and wherein said casing is closed at the top by a generally bell-shaped portion, said portion of the casing overlying said central chamber to close the same at the upper end.

4. An assembly according to claim 1 wherein a lifting means for raising and lowering said casing encompassing the tubular members is disposed within the space defined by the innermost one of said tubular members, said lifting means extending coaxially with said innermost tubular member along the length of said member occupied by the respective discharge ends of the cyclones.

5. An assembly according to claim 4, wherein said lifting means comprises a hydraulic cylinder piston-drive operatively coupled with said casing.

6. An assembly, according to claim 5, wherein said lifting means further comprises means for securing the casing in a selected position of elevation in reference to the tubular members.

7. An assembly, according to claim 1, wherein the innermost one of said tubular members and the casing define a closed central chamber, the end of each of said cyclones facing the center axis of the stack including one of said openings, said opening issuing into said central chamber for collecting separated material in said chamber.

8. An assembly, according to claim 1, wherein the innermost one of said tubular members and the casing define a closed central chamber, the end of each of said cyclones facing the center axis of the stack including a discharge opening issuing into said central chamber for collecting separated material in said chamber, and wherein a lifting means is disposed in said central chamber coaxially therewith and extending along the length of said chamber occupied by the respective discharge ends of the cyclones for raising and lowering said casing in reference to said tubular members and said end walls.

9. An assembly, according to claim 1, wherein said cyclones are of generally conical configuration, the narrow ends of the cyclones facing said center axis of the stack, and wherein the walls of said tubular members include transversely aligned openings, and cyclones being extending through said openings in sealing engagement with the rims of the openings whereby the cyclones are supported and located by said tubular members.

10. An assembly, according to claim 9, wherein said casing and the cyclones have portions co-acting with each other to prevent lengthwise displacement of the cyclones in the direction toward said casing, said openings in the tubular members decreasing in diameter from the outermost tubular member towards the innermost tubular member to prevent displacement of the cyclones in opposite direction.

11. An assembly, according to claim 10, wherein the end of the cyclones received in the outermost tubular member includes one of said openings to discharge through said opening lights in the material to be separated, and wherein said end of each cyclone is radially extended close to the casing, thereby preventing lengthwise displacement of the cyclones toward the casing, said extended portions of the cyclones each constituting a deflector for discharged lights.

12. An assembly, according to claim 1, wherein the lower end wall includes several ports, and comprising a manifold block including ducts connected to each of said ports for supplying the suspension to the respective chamber and discharging collected separated material from the respective chambers, said manifold block constituting a support for the cyclone assembly.

13. An assembly, according to claim 12, wherein said duct for supplying the suspension is centrally located in said manifold block.

14. An assembly, according to claim 1, wherein said tubular members and said casing define a central chamber and three annular chambers encompassing the central chamber, and comprising conduit means connected to the innermost one of said annular chambers for supplying flushing liquid to said chamber to flush out sludge accumulating in the cyclones, conduit means connected to the intermediate one of said annular chambers for supplying suspension to said chamber, and conduit means connected to the outermost one of said annular chambers to discharge lights in the separated material, the central chamber being a chamber for collecting heavies in the separated material.

15. An assembly, according to claim 1, wherein sealing means are provided between the casing and said upper and lower end walls, said sealing means being substantially equally spaced from the center axis of the casing whereby the casing is substantially free of axial pressures due to a pressure differential between said further chamber and the ambient atmosphere.

16. An assembly, according to claim 15, wherein said casing portion is of cylindrical configuration.

17. An assembly, according to claim 1, wherein the innermost one of said tubular members and the casing define a closed central chamber, the end of each of said cyclones facing the center axis of the stack including a discharge opening issuing into said central chamber for collecting separated material in said chamber, and wherein an elongated body is centrally disposed in said central chamber along the length thereof, said elongated body constituting a deflecting means for preventing said separated material from any of the discharge openings to reach a diametrically opposite discharge opening, and wherein a lifting means is disposed in said elongated body for raising and lowering said casing.

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