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- (72) Inventor; and
- (71) Applicant : EIGAMIL, Mohamed Ahmed [EG/EG]; 7 Alfariq Mohamed Ali Fahmi, Nazlet Albatran, Alharam, App# 19, Giza (EG).
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- (54) Title: PROCESSING FLUIDS BY PASSING THROUGH HELICAL PATH(S) AND BEING SUBJECTED TO ELECTRIC OR MAGNETIC FIELD

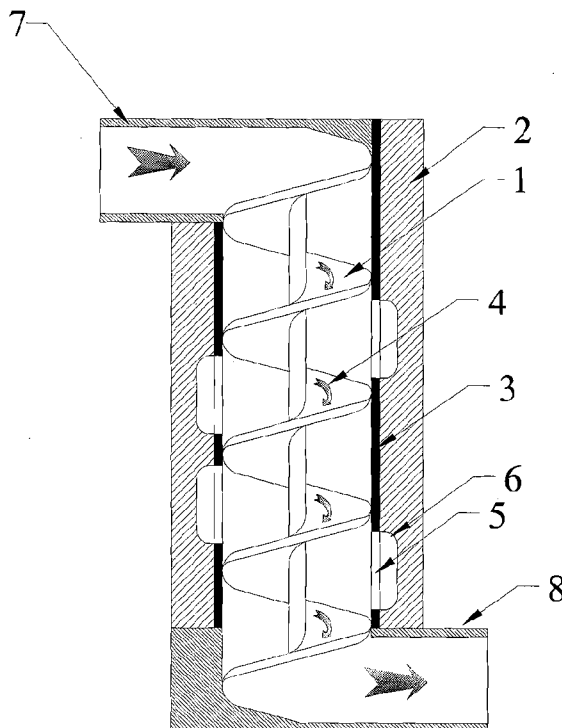


Fig. 1

(57) Abstract: A method to purify and separate fluids by means different from filters, centrifugal or electrostatic conventional equipment and devices is presented. The method uses a helical flow path without restrictions to generate a centrifugal action, where the small radius of fluid rotation inside the helical path is utilized to generate a large centrifugal force without need of a powered rotor. The components can be adapted to utilize electric and/or magnetic fields in addition to centrifugal force. Electric and magnetic fields can provide further chemical and physical processing capabilities. The separated materials exit the helical path through side openings and could be collected in buckets, vessels or fed to other ports.



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Processing Fluids by Passing through Helical Path(s) and Being Subjected to Electric or Magnetic Field

Technical Field

5 The field of purifying fluids, separating fluid mixtures and removing contaminations utilizes many devices and equipment such as filters, centrifugal machines and electrostatic oil cleaners. The presented equipment or device uses the centrifugal force to separate liquids from liquids, liquids from gases, gases and solid particles from liquids or gases. Magnetic field can be additionally applied to collect ferrous materials and materials responds to
10 magnetic fields. If electric or electrostatic field is also applied, the equipment can provide chemical or physical processing in addition to electrostatic and centrifugal forces. Thus; the technical fields are separating fluids, purifying fluids and chemical and physical processing of solutions and mixtures that can flow through the helical paths.

Background Art

15 Separating mixed materials is required in industry and daily life. Purifying fluids as an application of materials separation means separating unwanted elements from the fluid, for example solid contaminations from water, oils and gases or separating water from air and oil. The methods are mainly three techniques as follows:

- 20 1- Filtration: filtration means pumping the fluid through a screen with porosities of dimensions small enough to prevent solid contamination of larger size from passing. The screen is made of different materials as a disposable or cleanable cartridge. Water filter cartridge may provide a good environment for bacteria farms. Cartridge capability to hold contamination is limited and hence it is not the best selection for cost effective solution. Filters are widely used in almost all industries including food,
25 petrochemical, heavy, automotive, mobile machinery and power plants.
- 2- Centrifugal equipment: they depend on rotating the fluid at high speed and hence heavier elements will be collected at the outsider barriers. The rotation is generated by a central rotating element, or by injecting the fluid tangent to a circular rim to generate a cyclone in what is called sometimes “element-less filter”. The technique is

generate a cyclone in what is called sometimes “element-less filter”. The technique is used to separate solid contaminations and water from oils; however it cannot efficiently separate fine solids like filters. Limitations are the required power to generate centrifugal action, especially when the fluid is thick and viscous and the amount of oil being cleaned on a time is large. Such kind of equipment is not suitable to be always used online with the fluid operating circuits.

3- Electrostatic oil cleaners: Depending on passing the oil between anodes and cathodes sheets, the electrostatic field leads to charge the contamination and separate them to lodge inside porous tissues. It has great capabilities to hold large amount of fine contamination compared with filters. Initial cost is large, however running cost is economical. Two main factors limit its capabilities; the amount of oil being cleaned on a time, and the maximum water content allowed in the oil to be cleaned. Water based industrial oil such as water glycol cannot definitely be cleaned by this technique. This equipment works mostly offline.

Centrifugal machines are also used in separating different materials, not necessarily purifying or cleaning, based on their density difference. This application is widely used in industry, especially in food, chemical and petrochemical industries. On the other hand, applying electric or magnetic fields on the flowing fluids can be utilized in further chemical and/or physical processing such as ionizing and attracting different mixtures or compounds.

Disclosure of Invention

- Technical Problem

As described in the background art, filter cartridge has its limitations on the contamination size that can be hold, the amount of the hold contamination and the pressure drop that generated and increases with the amount of contamination accumulated on cartridge. This pressure drop means power loss. Cartridge replacement is not economic regarding running cost. Bacteria farms that can be formed when being used to purify water is another health issue.

Cyclones are working effectively when the densities differences are large enough to separate the materials; and they are weak when the rotation is a part of a cycle or few cycles.

Centrifugal machines requires a central rotor that rotates at very high speed, that results in consuming huge power especially with viscous fluids, restricting the minimum rotating radius due to the existence of the central rotor, and necessity to use equipment to step up the driving motor rotating speed.

Electrostatic oil cleaning machines necessitates using electric power, and its efficiency is excellent but its productivity is limited.

The new separating and purifying technique is suitable to apply electric, electrostatic and/or magnetic fields in addition to the centrifugal force for further chemical or physical processing. There is no need to use powered rotor, thus it has high efficiency and could utilize very small radius of rotation to generate very large centrifugal force. No screens means less pressure drop. Contaminations are hold away from the path, thus if bacteria farms are formed, they will be away from the produced clean water, if use to purify water in end users taps or large scale industrial plants. The equipment is cleanable and flexible in design to serve lot of purposes.

- Solution to Problem

The centrifugal force depended on two factors, the square of tangential velocity and the radius of rotation. In other words, the force value is proportional to the square of the tangential velocity and proportional to the reciprocal of the radius of rotation. This invention

utilizes both the centrifugal force factors: the velocity and the small radius of rotation, allows the flow to go freely through as many as turns the process requires, does not need any rotating component and can apply electric, electrostatic and/or magnetic forces simultaneously with centrifugal force. The technique is to inject the flow into a helical path with inner radius as small as possible. The heavier substances are pushed to move close to the outer diameter by the effect of the generated enormous centrifugal force. Openings formed at the outer path wall are used to collect the heavier substances from the main flow stream. The technique provides a wide range of design parameters that can be utilized in several applications, design parameters such as variable screw pitch, variable helix angle and variable flowing cross-sectional area.

Figure1 shows a simple configuration of the purifier. The purifier consists of the helical screw (1), the housing (2) and optionally (necessary only when electric or electrostatic field is applied) the isolator (3). The flow (4) goes through the helical path of the screw, therefore the heavier substances will be accumulated at the outer radius by the centrifugal force effect and exits through the side opening (5) which may face part or all the of flowing cross-section. These heavier substances may be collected or discharged through the ducts (6). Inlet and outlet are marked as (7) and (8).

In case of applying the electrostatic field, the screw (1) can be the anode (or cathode), and then the housing (2) should be the other pole. The isolator (3) then prevents the bridging both the poles, and hence the flowing substances will be the media to be processed.

Figure 2 shows a cross- section in the purifier. Same item numbers are used to keep the description continuation. The heavier substances (9) are separated and move next to outer cylindrical surface. The side (or facing) openings (5) permits the heavier substances to leave and exit to the buckets (6).

The substances (9) are trapped in the bucket (10), where they can be extracted or drained via the port (11). The rod (12) –as an example for a special tools- could be used if the substances solidifies and clogs the port (10)

Figure 3 shows How to use a cleanable vessel (bottle 13) in collecting the heavier substance (14) away from the flow path. In case of utilizing this purifier in potable water purification, if bacteria farms are formed, they will be away from the flow path.

Figure 4 shows the screw (1), when made with two starts. Then, two separate flow paths can be formed so as to have two separate flows (4, 4'), two entrances (7, 7') and two exits (8, 8')

The flow path length and number of turns can be duplicated by bypassing the two exits 8 and 8' and then the second flow 4' will be reversed and the entrances 7' will be the new exit. By this way the purifier could be shorter, and drastic change in flow direction at the bypass zone could be further utilized. Three or more starts can also be utilized. No components rather than the screw and the inlets and exits are shown.

Figure 5 shows the screw (1) with a pitch varies along its length. This variation leads to varying both the flowing cross sectional area and the helix angle. Helix angle variation results in changing the tangential velocity component. These two variations provide more flexibility in the processes that can be processed by this purifier. Only the screw (1) and the ports (15) are shown, no other components are shown. The two ports (15) are given a number different from the inlet and outlet marks to indicate the flexibility to accelerate or decelerate the flow inside the device according to the application by choosing any of them as inlet and then the other will be the outlet.

Another variation is shown in Fig.6, where the pitch is fixed and the flowing cross-section is also kept unchanged. The outer and inner radii are the changed parameters in this case. Still the pitch can be also changed.

In Fig.7, the pitch and the inner diameter are kept unchanged, however the outer diameter and hence the flowing area are changed.

The varieties provided by the Figures 4, 5, 6 and 7 are only example of how to change the parameters that could be utilized in different ways and processes. Flow velocity, tangential velocity component, degree of momentum change, path length and number of turns are good shown examples for variation possibilities.

Brief Description of Drawings

Figure 1 shows a longitudinal section of a simple configuration of the equipment or device, main and optional components are illustrated.

5 Figure 2 shows a cross section of a simple configuration of the equipment or device. The figure shows how to form a port to extract the separated substance. A bucket can be plugged to trap the substance as shown, or extracting line can be attached. A special tool such as a bar can be used to remove the solidified materials.

Figure 3 shows a cross section of a simple configuration of the equipment or device. It shows how to use a reusable or cleanable vessel to collect the separated material.

10 Figure 4 shows a longitudinal section of only a helical screw with two starts, two inlets and two outlets. The other components (housing, openings, etc.) are not shown.

Figure 5 shows a longitudinal section of only a helical screw with variable pitch, the inlet and the outlet. The other components (housing, openings, etc.) are not shown.

15 Figure 6 shows a longitudinal section of only a helical screw, the inlet and the outlet. The helix has a fixed pitch but variable inner and outer radii. The other components (housing, openings, etc.) are not shown.

Figure 7 shows a longitudinal section of only a helical screw, the inlet and its outlet. The helix has fixed pitch and inner radius and variable outer radius. The other components (housing, openings, etc.) are not shown.

Industrial Applicability

The equipment or device has very wide applications in a wide range of industries. For examples, it can be used instead of filters in new machines or replace filters in machines in service without costly or complicated modifications in the following applications.

- 5 1- Water cleaning in homes, small to medium plants to serve small and remote societies or plants of mass production
- 2- Oil cleaning in lubrication and hydraulic circuits and systems.
- 3- Lubrication circuit online cleaning in internal combustion engines, then no need to use extra filter
- 10 It can replace centrifugal machine in the following applications:
 - 1- Fuel cleaning
 - 2- Drying compressed air
 - 3- Removing oil from compressed air
 - 4- Cleaning fluids
- 15 5- Removing water from industrial oil
- 6- Separate various fluids

In addition to these cleaning and separating applications, chemical and physical process can be obtained by applying electric, electrostatic or magnetic fields in addition to the generated centrifugal force.

CLAIMS

- 1- A device to separate, process or purify fluids by using centrifugal force resulting from moving the flow through a helical path.
- 2- A device as in item no.1, in which the helix is formed by a screw path, and the
5 flowing area is determined by the helix wall, its inner and outer diameters and the containing and surrounding wall.
- 3- A device as in items 1 and 2, where the screw could have more than one start, each of them forms a separate path.
- 4- The paths in item no.3, where they could be connected in series or parallel.
- 10 5- The helical paths as in item 1 to 3, where the helix angle can be made fixed or variable by varying the pitch along the screw.
- 6- The helical path as in item 1 to 5, where the screw inner diameter and/or the screw outer diameter could be made fixed or variable along the screw.
- 7- A device as in item 1 to 6, where the core screw and the housing could be made from
15 electric conductive materials and separated by a buffer made of electric isolating material to isolate them electrically.
- 8- A device as in item no.7, where the inner and outer conductive materials could be connected to electric source.
- 9- A device as in items 1 to 7 where electric field can be applied along the path.
- 20 10- A device as in items 1 to 7 where magnetic field can be applied along the path.
- 11- A device as in items 1 to 10, where the separated materials are extracted from side and/or flow facing openings along the flow path.
- 12- A device as in items 1 to 11, where if more than one screw starts are used and two successive paths are connected in series, an extracting opening could be formed
25 facing the flow at the connecting zone.
- 13- A device as in items 1 to 12 where the separated materials extracted from side and flow facing openings along the flow path could be collected inside buckets.
- 14- Buckets as in item no. 13, where special tools could be used to clean them.
- 15- A device as in items 1 to 12 where the separated or processed materials extracted
30 from side and/or flow facing openings along the flow path could be collected in cleanable and reusable vessels.

16- A device as in items 1 to 12 where the separated or processed materials extracted from side and/or flow facing openings along the flow path could be fed to branch ports and pipelines.

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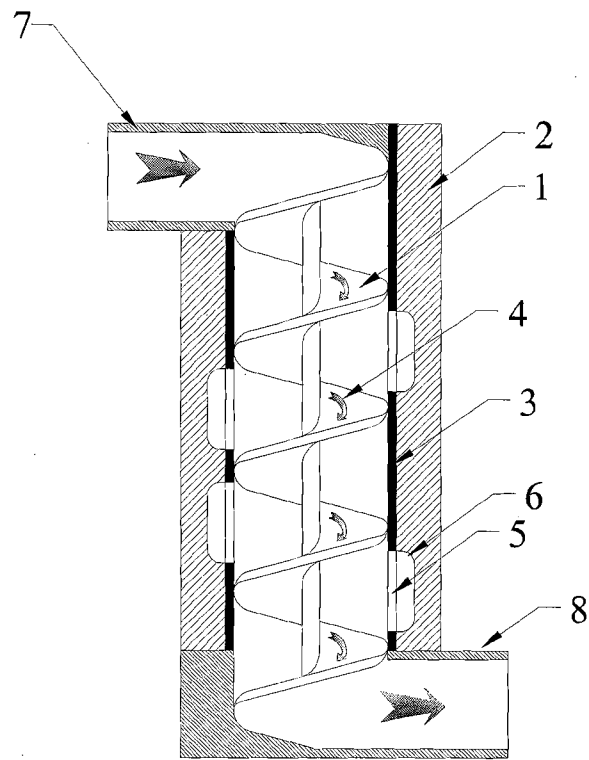


Fig. 1

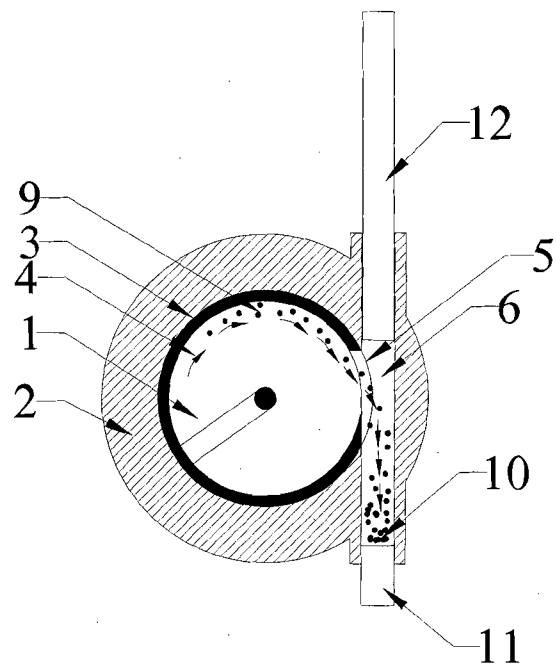


Fig.2

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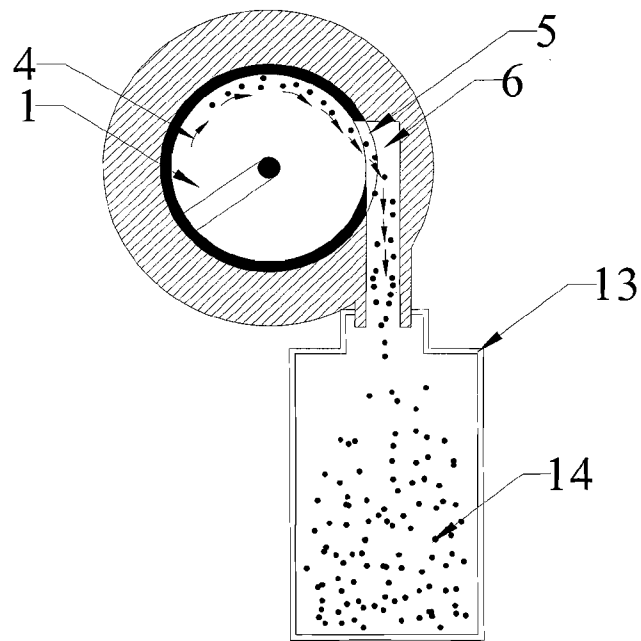


Fig.3

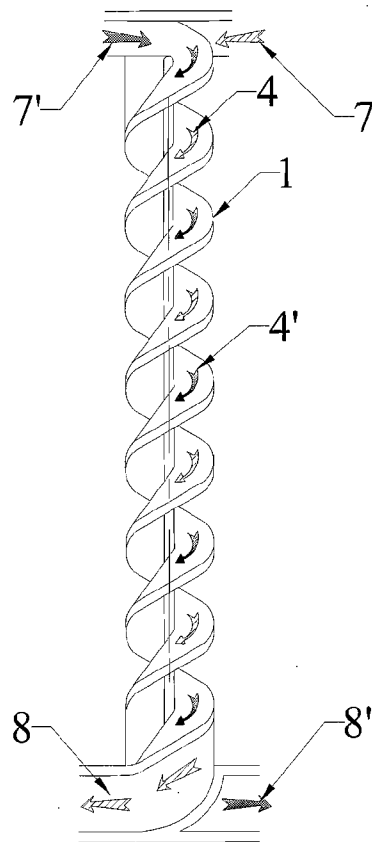


Fig.4

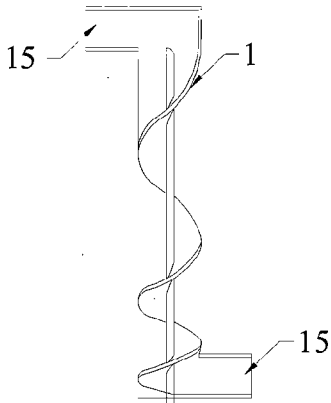


Fig.5

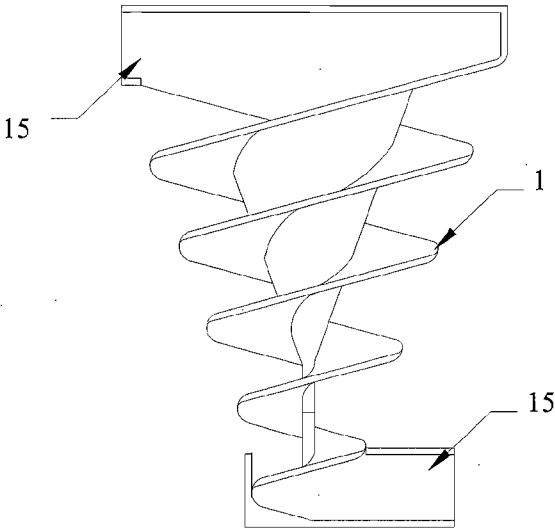


Fig.6

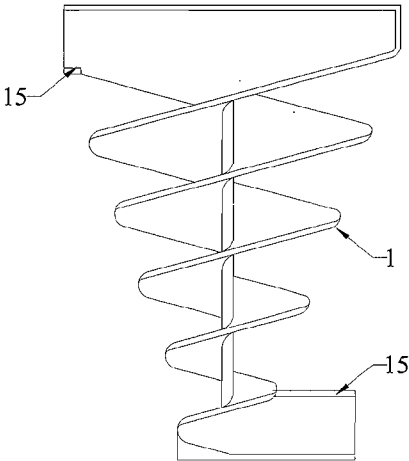


Fig.7