Dec. 16, 1969 C. WOLKENHAUER 3,483,984

DEVICES FOR REMOVING IMPURITIES FROM FLUIDS

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Fig. 1

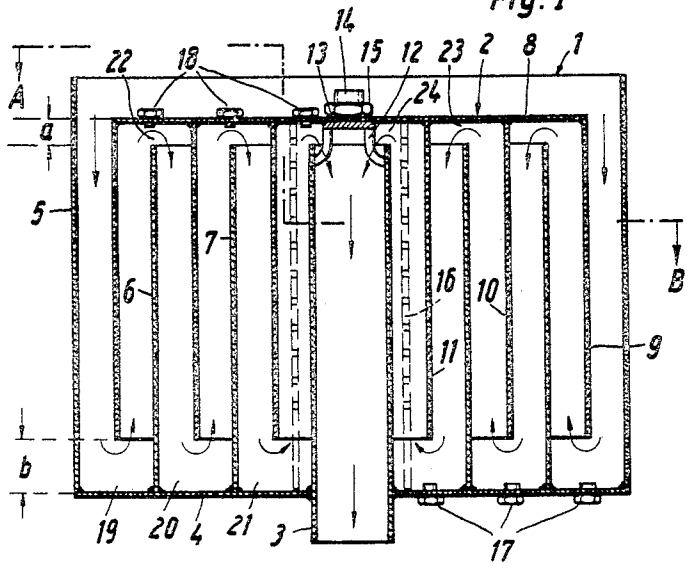
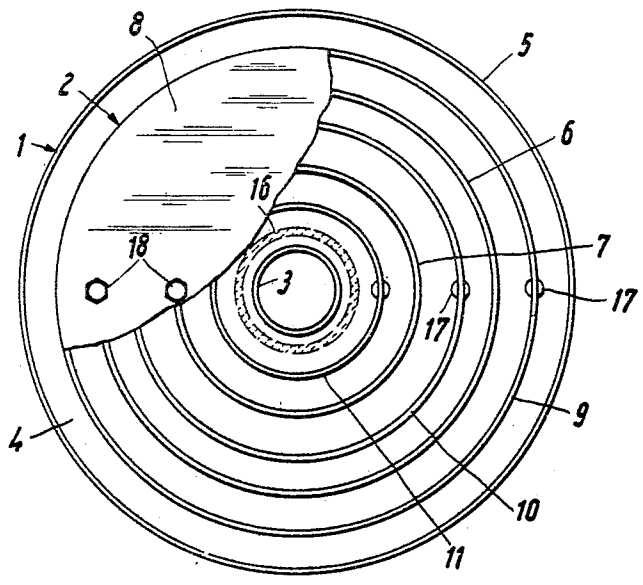


Fig. 2



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DEVICES FOR REMOVING IMPURITIES FROM FLUIDS

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Fig. 3

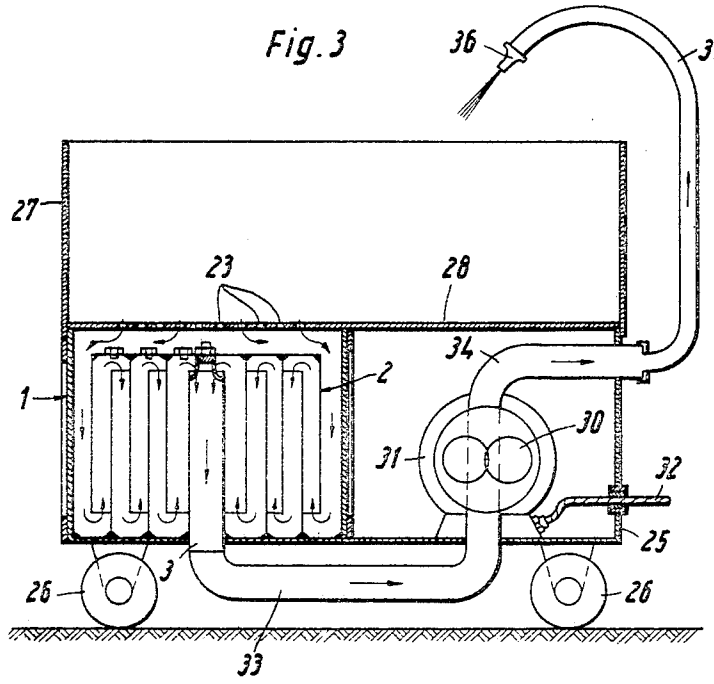
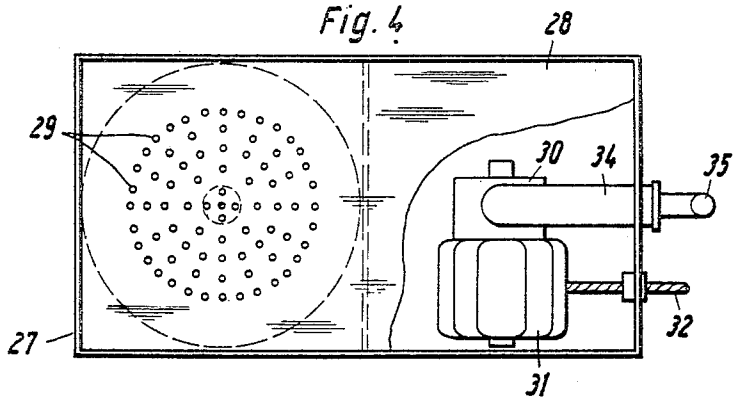


Fig. 4



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DEVICES FOR REMOVING IMPURITIES FROM FLUIDS

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Fig. 5

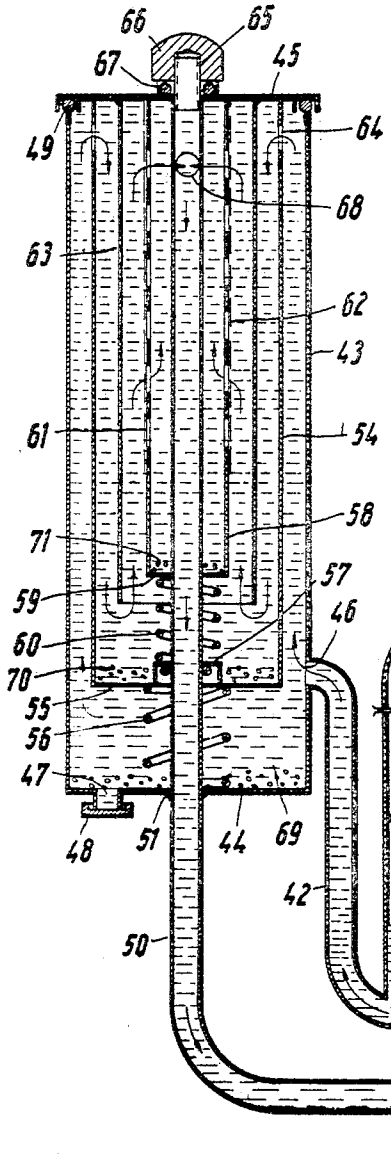
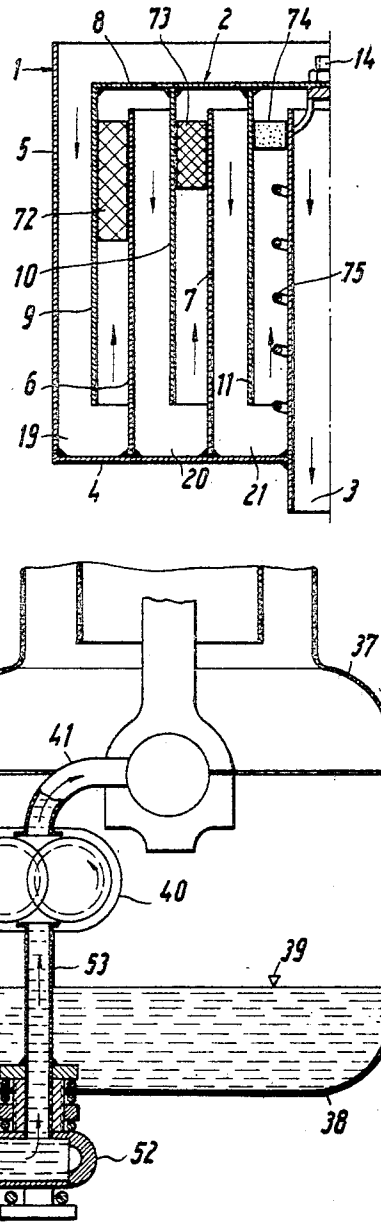


Fig. 6



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DEVICES FOR REMOVING IMPURITIES FROM FLUIDS

Filed March 6, 1967 4 Sheets-Sheet 4

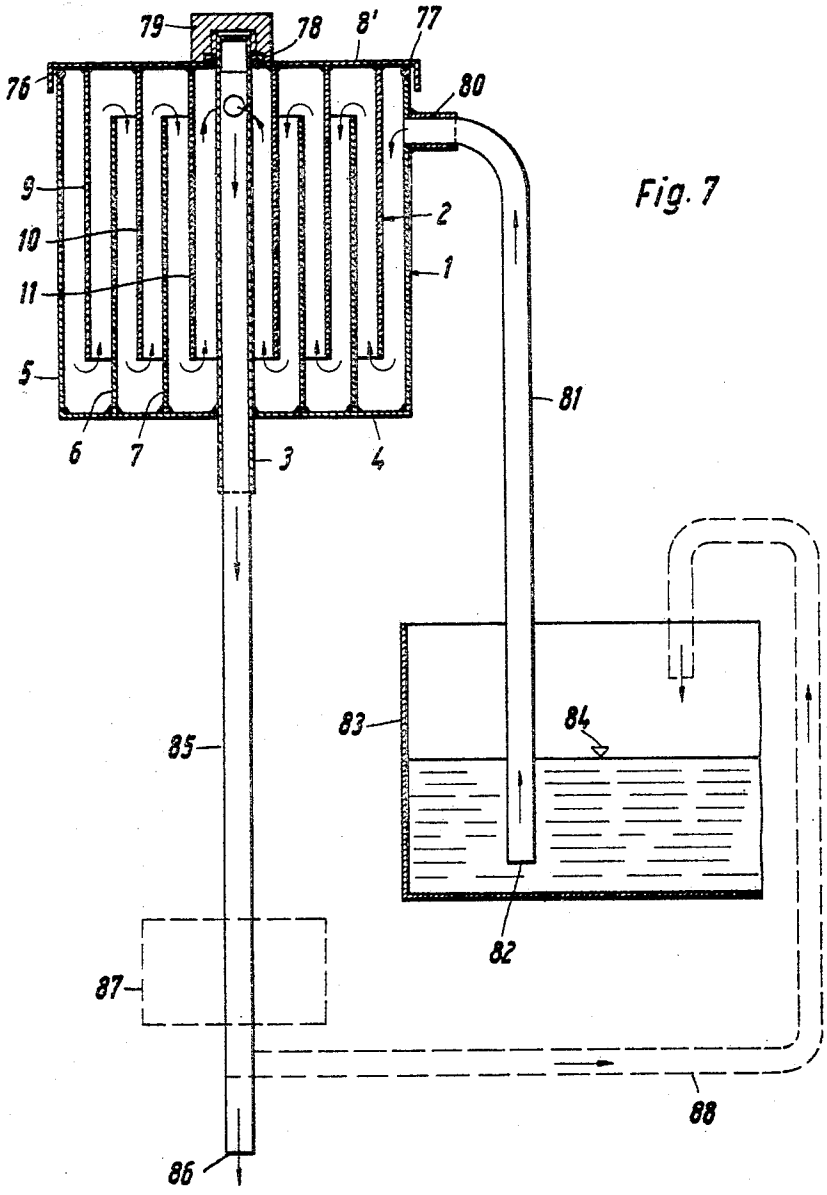

Fig. 7

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3,483,984

DEVICES FOR REMOVING IMPURITIES FROM FLUIDS

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Int. Cl. F01m 11/02, 11/00
U.S. Cl. 210—168 12 Claims

ABSTRACT OF THE DISCLOSURE

In accordance with the invention fluid cleaning devices of the type comprising a sub-divided container in which particles suspended in the fluid are allowed to settle are operated by applying suction to the outlet of the container so that the fluid flows without turbulence. In accordance with another feature of the invention, the settling container is sub-divided by the depending part of a bell-shaped guide, or several such depending parts.

Applications of the invention include garage equipment used for cleaning parts by means of a bath or jet of liquid and IC engine lubrication systems.

The present invention relates to cleaning devices for fluid media and more particularly media such as lubricating oil, water, or aqueous solutions of cleaning agents, in which the medium to be cleaned is passed into a sub-divided settling container via at least one settling chamber serving for the deposit of impurities or the like.

Known devices of the above type operate with open settling chambers, that is to say chambers open to the atmosphere, or with settling containers into which the liquid has to be fed by means of a pump or by a reservoir placed at a higher level. The use of a reservoir is however only possible in exceptional circumstances. Also closed filter devices working under a high pressure are known which naturally require a large degree of power for their operation. The settling chambers are generally placed adjacent to each other or in series and the dimensions of such cleaning devices are comparatively large. The powerful or rapid flow in the devices of the medium caused by the medium being subjected to a gage pressure leads to turbulence which is undesired since it hinders deposit or settling of the impurities from the medium.

The object of the invention is to remove these and other defects of known devices for cleaning fluids, and to develop a particularly simple device which is cheap to produce, effective and dependable in operation and can be used with liquids of all types, and also, in certain circumstances, with gases. The device of the invention is intended to meet practical requirements more effectively than known devices and is of universal application.

The invention consists substantially in that in the settling container of the cleaning device, a bell-shaped guide part or the like, which has a fluid-tight top part and ends above the settling container bottom, is used to form a space at a subatmospheric pressure from which the cleaned medium is drawn off making use of the effect of atmospheric pressure on the medium upstream from the guide part, using a suction tube or the like. The subatmospheric pressure can be produced in a particularly simple manner by using a siphoning effect, though it is also possible to use a suction pump coupled with the suction tube, the outlet connection of the pump being connected via a pressure pipe, as may be required; for example, the pressure pipe can lead to a collecting container or to a pipe system.

Such a cleaning device not only possesses a particularly simple construction but can also be accommodated in a comparatively small space, is trouble free in operation, and serves for the removal of coarser and finer impurities and other foreign bodies from the fluid so as to achieve a high degree of purification. The medium to be purified flows practically without turbulence through the settling containers from which the residue collected from the fluid can be removed comparatively easily. The use of the siphon principles enables the device to be arranged in a manner adapted to particular space requirements or to make access more readily available The number of the settling chambers provided depends upon the particular circumstances occurring in the case of application in view, and also upon the nature and quantity of the impurities to be removed, as well as on the degree of purification required. It is also comparatively easy to provide coarse and fine filters and sieves or the like between the settling chambers as an addition.

In accordance with a particularly practical and compact embodiment of the invention, the settling container, the bell-shaped guide part, the suction tube, and the settling chambers of the cleaning device are arranged concentrically in relation to one another. Preferably a cylindrical cross section is chosen for the device, though it is also possible to use polygonal or rectangular cross sections.

The formation of two or more concentric settling chambers inside an approximately pot-shaped cleaning device can be realised, in accordance with a preferred feature of the invention which is particularly simple, by making the settling container so that it is sub-divided into two or more inter-spaces by means inside its outer casing including one or more intermediate casings which are connected in a fluid-tight manner with the bottom of the container and above, at a position below the horizontal part of the guide part, provide passages; in a corresponding manner the guide part with a bell shape is then provided inside its outer casing with one or more intermediate casings which are then connected with the horizontal part of the guide part in a fluid-tight manner, extend in a downward direction between the intermediate casing or casings of the settling container and the suction tube and end some distance above the bottom of the container. Below the bottom of the settling container, there are thus formed settling chambers which are concentric about the central suction tube from which the deposited residue can be removed, if required, by openings in the bottom of the container, provision being made for closing the openings.

If the space available for the cleaning device is limited in a radial direction, the settling chambers can be arranged concentrically in relation to a central suction tube, using the basic principle of the invention, while being arranged axially one above the other.

The settling container can open above the bell-shaped guide part and the liquid to be cleaned can flow downwards, through the space between the outer casing of the settling container and the outer casing of the bell-shaped guide part in a downward direction, and under the guide part. This form of construction is, e.g., particularly well-suited for removing particles in small and large enterprises, in repair garages, and the like because the dirty cleaning fluid can flow from a cleaning container arranged above the settling container and downwards into the settling chamber, which it leaves after cleaning through the suction tube in a circuit leading to the washing container or through a nozzle. In accordance with another embodiment of the invention which is especially suitable, for example, for use as an oil cleaner in stationary or motor vehicle IC engines, the settling container can also be closed, preferably by an enlarged hori-

zontal part of the bell-shaped guide part. The supply of the oil to be cleaned from the engine sump can take place through a lateral inlet connection on the settling container. In this case, the sump forms the collecting container for the liquid which is placed at atmospheric pressure, which leads to the formation of a subatmospheric pressure zone in the suction tube producing a siphoning effect.

Further possibilities of application of cleaning devices in accordance with the invention include, for example, water purifying arrangements, purifying arrangements for waste oil or other liquids, and other clarifying and filtration plant. If required, the subatmospheric pressure principle of the invention can also be used for the cleaning of air and gases, for example, in air-conditioning plant or the like, in which case the settling container can be operated with or without a charge of water.

In what follows various examples of the application of the invention are described referring to the drawings; though it is to be understood that the scope of the invention is not to be limited to these embodiments or applications of the invention. The description following also refers to further advantageous forms and individual features of the invention, for which protection is claimed. Also the invention covers all modifications of its essential principle, these modifications being determined in accordance with the particular application in view.

The drawings show various embodiments of the invention by way of example only.

FIG. 1 is a vertical section of a cleaning device in accordance with the invention using three concentric settling chambers.

FIG. 2 shows the cleaning device partially in horizontal section on the line A–B of FIG. 1.

FIG. 3 is a diagrammatic vertical section of a travelling device for cleaning workpieces with a cleaning device in accordance with FIGS. 1 and 2 as component of the cleaning device.

FIG. 4 shows the washing device of FIG. 3 in elevation with the bottom of the washing container partially broken away.

FIG. 5 is a diagrammatic vertical section of the bottom part of a motor vehicle engine with an oil cleaning device in accordance with a modified embodiment of the invention.

FIG. 6 is a vertical section of a cleaning device in accordance with the invention using filters and heating means.

FIG. 7 is a diagrammatic vertical section of a further embodiment of the cleaning device for liquids, a possible modification being indicated in broken lines.

The cleaning device shown in FIGS. 1 and 2 consists substantially of a pot-shaped settling chamber **1**, a bell-shaped guide part **2** in the container **1**, and a suction tube **3**. The settling container **1**, the part **2** and the suction tube **3** have circular cross sections in accordance with this embodiment of the invention and are placed concentrically inside one another. Preferably these parts are made of sheet metal, though if required they can be made of another material such as plastic.

The settling container **1** comprises a container bottom **4**, an outer casing **5**, and two annular intermediate casings **6** and **7** whose lower edges are welded or otherwise connected with the container bottom **4**. In the middle the container bottom **4** has an opening through which the suction tube **3** passes and is welded or otherwise connected with bottom **4**.

The bell-shaped guide part **2** comprises a horizontal part **8**, an outer bell-shaped casing **9**, an annular intermediate casing **10**, and an inner annular casing **11**. The casings **9**, **10** and **11** are welded or otherwise connected with the part **2**.

The part **2** is arranged concentrically in the settling container **1** in such a manner that the upper edges of the intermediate container casings **6** and **7** and the upper edge of the suction tube **3** are spaced at a distance *a* from the horizontal part **2**, while the lower edges of the intermediate casings **9**, **10**, and **11** are at a distance *b* above the container bottom **4**. The distance *b* is preferably greater than the distance *a*. In order to fix the position of the part **2** as required in the chamber **1** in a simple manner, the embodiment includes a support plate **13** which is attached by bolts **14** to the upper end of the suction pipe **3** using support straps **12**. The part **2** has a central hole with which it is placed over the bolt **14**, lies on the carrier **13** and is clamped in position by means of nut **15**.

Between the suction tube **3** and the inner casing **11** it is possible to provide an annular sieve **16** (if required) in the form, for example, of a perforated tube of wire fabric or the like. The container bottom **4** is provided between the concentric casings **5**, **6**, and **7** with outlet openings which are normally closed by means of screws **17**; while the horizontal part **2** is provided at positions between the casings **9**, **10**, and **11** with discharge holes which are normally closed by means of screws **18**.

With this arrangement of the bell-shaped guide part **2** in the settling container, annular settling chambers **19–21** are formed in the lower part of the settling container **1** between the container casings **5–7** and below the lower edges of the casings **9–11**, while in the upper part of the part **2**, annular entry slits **22–4** are left between the upper edges of the intermediate casings **6** and **7** and of the suction tube **3**, on the one hand, and on the other, the horizontal part **8** of the guide part.

The liquid to be cleaned is introduced in the top part of the settling container and flows in the direction of the arrows down between the casings **5** and **9**, through the settling chamber **19** again between the casings **9** and **6** in an upward direction, then through the annular slit **22** and the casings **6** and **10** downwards, through the settling chamber **20** and the casings **10** and **7** in an upward direction, through the annular slit **23** and the casings **7** and **11** downwards, through the settling chamber **21**, between the casing **11** and the tube **3** upwards, and finally through the circular slit **24** into the suction tube **3** in a downward direction. The suction tube **3** can be connected with a suction pump, though it is also possible to use a siphoning or lifting effect in order to suck the liquid along the path indicated through the device. Along this path the coarse, medium and fine impurities etc. settle in the settling chambers **19–21**. Any remaining impurities are held back by the tubular sieve **16**. Oil or oily matter from the liquid rises in the annular spaces and forms a layer which can be removed from time to time after removal of the part **2** from the container **1**. The impurities, slime, etc can be drawn off from the bottom of the settling chamber **19–21** by removing the closing screws **17** from the outlet openings.

The cleaning device described with reference to FIGS. 1 and 2 can be used for a large number of purposes such as cleaning water, waste oil, and also air and gases, in which case, filter elements or charges of water or other suitable liquids can be used in the device.

FIGS. 3 and 4 show a particularly advantageous example of application of the invention in the case of a device for washing dirty workpieces or components in small and large-scale industries. Preferably the device is provided with wheels so as to travel and is used for, or adapted for, cleaning heavily contaminated oily parts in repair garages.

The device consists of a sub-frame **25**, preferably clad with sheet metal, and is carried on wheels or castors **26**. On the frame **25** a removable washing container **27** is fixed. In the sub-frame **25** there is accommodated a cleaning device consisting of a settling container **1** and a bell-shaped guide part **2**, made, for example, as indicated in FIGS. 1 and 2. The bottom **28** of the washing container **27** lies above the cleaning device **1**, **2** and has holes **29** through which the washing liquid can flow, as

indicated by the arrows, into the settling chamber **1**, above the part **2**.

On the sub-frame **25** at a position adjacent to the cleaning device a pump, for example, a gear pump **30**, driven by an electric motor **31** connected with a cable **32** which in turn is connected with switches and fuses which are not shown in the embodiment in order to simplify the drawing. The bottom end of the suction tube **3** of the cleaning device **1**, **2** is connected with the pump **30** by means of a suction pipe **33**. A pressure pipe **34** leads from the pump **30** to a hose **35** above the sub-frame **25** and the hose is connected with a nozzle **36** for directing a jet of the clean washing liquid on to work-pieces placed in the washing container **27**. The dirty washing then flows via holes **29** into the cleaning device **1**, **2** and is removed from the cleaning device by pump **30**, and then returns in a clean condition through the hose **35** back into the washing container **27**.

FIG. 5 shows an embodiment of the invention which can be used for vehicle engines or stationary engines. An engine housing or crankcase **37** is connected with a sump **38** in which, above the oil level, I provide an oil pump **40** which passes the oil through a pressure pipe **41** to the crankcase bearings and other lubrication points.

From the bottom part of the sump **38** a pipe **42** runs in an upward direction to an oil cleaning device which utilizes the principle already described with reference to FIGS. 1 and 2. This cleaning device can, as was the case with the device of FIGS. 1 and 2, comprise a settling container **1** and a bell-shaped guide part **2**, in which the annular settling chambers are arranged in the same plane concentrically to one another. However in view of the limited amount of space below the bonnet of vehicles, a construction of oil cleaner in accordance with FIG. 5 is more advantageous. In this construction the settling chambers are arranged concentrically about the axis of the device and lie one above the other along the axis.

This oil cleaner consists of a tubular outer container **43** which is closed in a completely fluid-tight manner by a horizontal part **44** and a removable cover **45**. Into the bottom part of the outer container **43** there opens a hole **46** connected with a supply duct **42** coming from the sump **38**. In the horizontal part **44** there is an outlet opening **47** which has a connection closed by a screw **48**. The cover **45** is sealed by means of ring seal **49** engaging the top of the container tube **43**.

Along the central axis of the container **43** there runs a suction tube **50** which at **51** passes through a hole in the horizontal part **44** to which it is connected by welding or otherwise. The suction tube **50** opens into a sieve element **52** or the like and is connected in the latter with a suction pipe part **53** which passes through the bottom of the sump **38** and is connected with oil pump **40**.

Concentrically arranged in relation to the outer container **43** I provide a somewhat shorter tubular inner container **54** with a bottom **55** through which the suction tube **50** also passes. The inner container **54** is supported by means of a compression spring **56** and is sealed against the suction tube **50** by an O-ring **57**. Above the bottom **55** of this inner container **54** there is a further shorter inner container **58** whose bottom **59** rests on a compression spring **60**. The tubular casing of the inner container **58** can be provided with openings **61** and be covered with a wire fabric sieve or filter fabric **62**.

A tube **63** concentric to the suction tube is attached to the container lid **45**, for example, by welding. This tube ends in the inner container between the container bottom **55** of the latter and the container bottom **59** of the second inner container **58**. The tubular casing of the inner container **54** is provided at its bottom end with slit-like openings **64**. The suction tube **50** runs upwards inside the perforated inner container **58** through the container lid **45** where it is firmly anchored. By means of an external thread **65** and a screw cap **66** on it, the container lid **45** is screwed on the other end of the suction tube **50** using a rubber sealing ring **67**, and thereby simultaneously pressed on to the ring seal **49** of the outer container **53**. The suction tube **50** has at least one wall opening **68** somewhat below the container bottom **45**.

In this manner several settling chambers are formed in the oil cleaner, that is to say, an outer settling chamber **69** above the container bottom **44**, a central settling chamber **70** above the container bottom **55**, and an upper settling chamber **71** above the inner container bottom **59**.

The oil circulates through the system so made up in the direction of the arrows indicated in FIG. 5. The whole of the oil surface **39** in the sump **38** is acted upon by the pressure of the atmosphere. On starting the engine, the oil pump immediately produces a sub-atmospheric pressure in the bottom end of the suction tube **50** so that the siphoning or suction effect of the device is started. The dirty oil from the oil sump **38** flows through the container so that impurities are deposited in the chambers **69–71**. The purified oil is then forced by the oil pump **40** through the pressure pipe **41** into the lubricating system of the engine and then finally collects again in the sump **38** and is then recirculated.

Such an oil cleaner can be used in all stationary and vehicle engines in which the oil circulation system includes a sump or other collection space. Apart from the settling or precipitation effect which is obtained by the serially connected settling chambers, the lubrication system in accordance with the invention has the further advantge that it can hold a greater quantity in the settling container. This is advantageous from the point of view of cooling the oil, and for this purpose, the settling chamber can be provided with cooling ribs which are subjected to an air current from a fan or to the air through which the vehicle travels. Residues from the oil can easily be removed. In accordance with the invention the oil cleaner is connected with the suction side of the oil circulation system and the oil sieve can be placed outside the sump, for instance in the connecting device **52** so that it is easily accessible. In the prior art oil systems the oil sieve was placed in the suction side of the system inside the sump upstream from the oil pump so that access was difficult. An auxiliary branch circuit filter on the pressure side of the oil system can be dispensed with so that costs are reduced. Also, the oil pump can be arranged at any desired position away from the sump and thus be made more accessible. From the practical point of view oil cleaning with a device in accordance with the invention is substantially improved. The bearings of the motor are less subjected to wear because metallic particles removed from engine components by friction are practically entirely removed from the oil. There is also the advantage that the oil has to be changed less often.

In the individual chambers or compartments of the settling container it is possible, as already mentioned, to arrange one or more sieves or filter elements. FIG. 6 shows for example three various coarse and fine filters **72** to **74**. Also this figure shows the use of a heating coil **75** which is preferably arranged around the suction tube **43**. A heating of the medium can for example be advantageous with a workpiece washing device in accordance with FIGS. 3 and 4 because the washing solution of such machines is more effective in a certain temperature range.

FIG. 7 diagrammatically shows a further particularly simple embodiment of the cleaning device in accordance with the invention. The settling container **1** and the bell-shaped guide part **2** are constructed substantially as shown in FIGS. 1 and 2 but the settling container is not open at the top but is closed by the enlarged horizontal part **8'** of the part **2** having a corresponding diameter. The part **8'** has a profile rim **76** and makes a joint with the outer casing **5** of the container **1** by means of a sealing ring **77**. The upper end of the suction tube **3** which is closed at this position is connected by means of a joint with a sealing ring **78** with a hole in the horizontal part **8'** and connected for example with a nut **79** which presses the part **8'** against the sealing ring **77**.

An ascending pipe **81** is connected with a lateral inlet

connection **80** of the settling container **1** and the bottom **82** of the pipe **81** dips into a liquid container, for example, in a container **83** below the level **84**. A suction or siphon connection **85** is joined with the bottom end of the suction tube **3** and has an outlet opening **86** above the level of the container **83**. This device can work without a pump solely by the siphoning action so that the liquid to be cleaned flows as indicated by the arrows from the container **83**, through the settling container **1** and the various settling chambers to the suction tube **3** and the siphon tube **85**. The liquid level **84** is subjected to the pressure of the atmosphere.

If the cleaner liquid is to be returned to the container, for example for use as a washing medium, a pump **87** is provided in the pipe **85**. The pump passes the liquid through a pressure pipe **88** back in an upward direction into the container **83**. Such a device can also be used as an oil cleaner in accordance with the device shown in FIG. 5.

What I claim is:

1. In a liquid circulation system comprising suction producing means and a cleaning device for removing suspended solid particles from liquid in the system, the cleaning device being arranged to take up liquid from the rest of system and return liquid to the rest of the system, the improvement that the cleaning device comprises: a settling container with a liquid inlet opening and a liquid exit opening; upright sleeves arranged in the container so as to surround one another and extending generally vertically, first plate-like means connected with the top ends of the sleeves in a fluid-tight manner; upwardly extending cylindrical baffles extending between the sleeves with clearances between the baffles and the sleeves; and second plate-like means connected with the bottom ends of the baffles in a fluid-tight manner, there being liquid passage apertures between the first plate-like means and the top ends of the baffles and liquid passage apertures between the second plate-like means and the bottom ends of the sleeves for allowing the liquid to move alternately upwards and downwards between baffles and sleeves on its way from the inlet to the outlet at a speed which is lower than the speed of sedimentation of the particles to be removed, the sleeves and baffles being fixed in relation to each other, the suction producing means being arranged to maintain a subatmospheric pressure at the outlet of the device.

2. The structure as set forth in claim **1** comprising a suction tube extending from the exit opening, which is arranged in the bottom part of the container, the suction tube extending upwards to a position near the first plate-like means.

3. The structure as set forth in claim **2** further comprising a pump for drawing off liquid through the outlet tube.

4. The structure as set forth in claim **1** in which the second plate-like means forms a bottom of the container, and the structure further comprises plugs in the bottom for the removal of settle solid particles.

5. The structure as set forth in claim **4** in which the suction tube has a lateral hole near its top end and above this hole is screw-threaded for holding the first plate-like means in position.

6. The structure as set forth in claim **5** comprising a nut screwed on to the top of the suction tube, the screw thread at the top end of the suction tube being a male screw thread in the nut.

7. The structure as set forth in claim **1** comprising a take-up tank, an inlet pipe connecting the container inlet with the tank, an outlet pipe connected with the container exit opening and ending at a lower level than the level of liquid in the tank.

8. The structure a set forth in claim **1** in the form of an apparatus for washing articles and additionally comprising an enclosure with a perforated bottom, a nozzle for directing a jet of liquid onto the articles, a pump for supplying liquid from the container to the nozzle, the perforated bottom being arranged over the container for flow of liquid from articles in the enclosure through the perforated bottom into the container for sedimentation of particles washed off the articles.

9. The strucure as set forth in claim **1** in the form of an engine lubrication system and further comprising a pump to supply oil from the container to engine bearings.

10. The structure as set forth in claim **9** comprsing two upright pipes connecting the container with the engine.

11. The structure as set forth in claim **1** in which the baffles extend down to different levels and the second plate-like means comprises discs at different levels attached to the respective lower ends of the baffles.

12. The structure as set forth in claim **11** comprising at least one filter insert between one such baffle and one such sleeve.

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JAMES L. DE CESARE, Primary Examiner

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