Jan. 18, 1955 W F. BUCK ET AL 2,699,793

CENTRIFUGAL CLEANER FOR AIR FILTERS

Filed Oct. 4, 1949 2 Sheets-Sheet 1

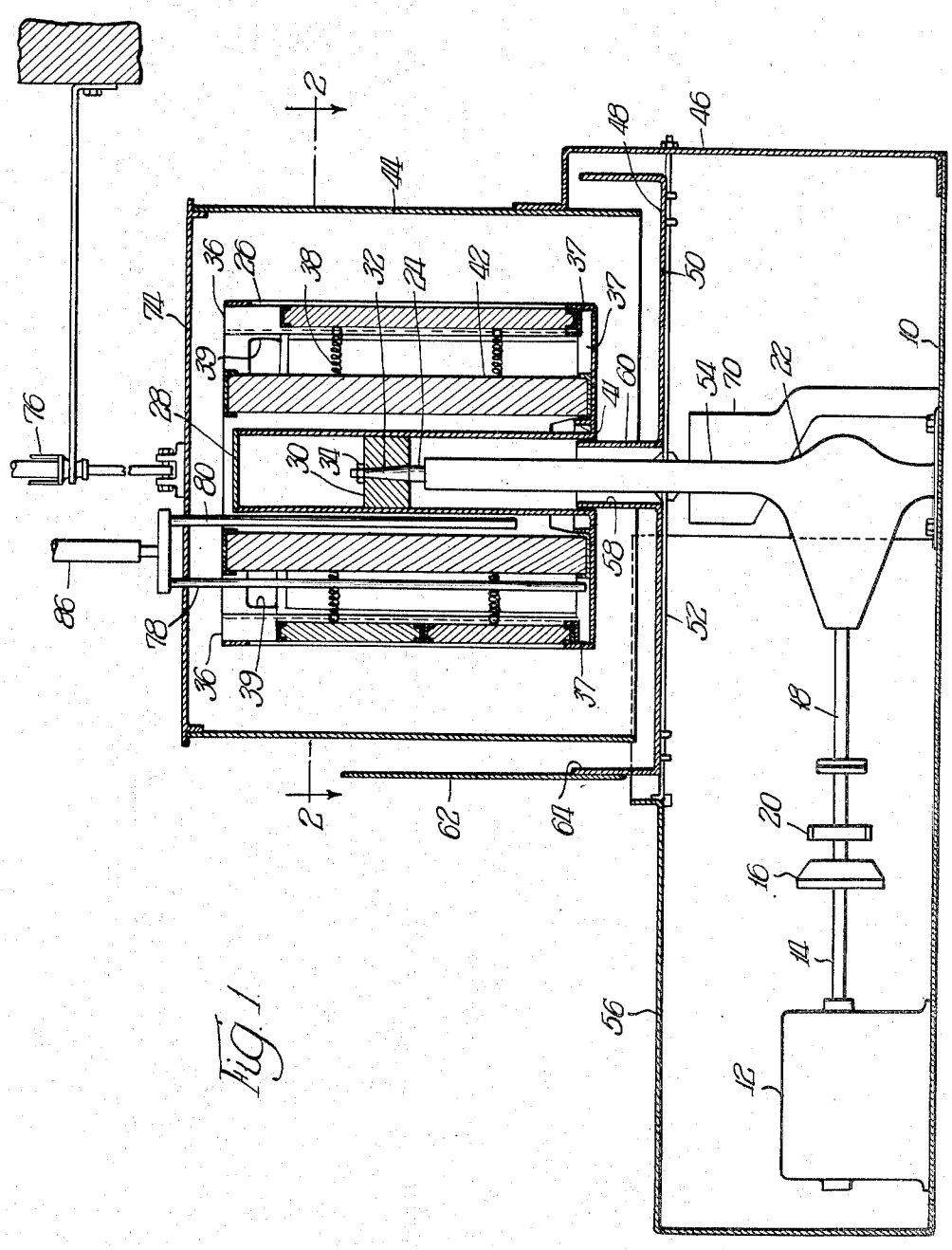


Fig. 1.

INVENTORS.
W. Floyd Buck
BY Ralph I. Thomas,
Wilkinson, Huxley, Byron, & Hume
Attys.

Jan. 18, 1955 W F. BUCK ET AL 2,699,793

CENTRIFUGAL CLEANER FOR AIR FILTERS

Filed Oct. 4, 1949

2 Sheets-Sheet 2

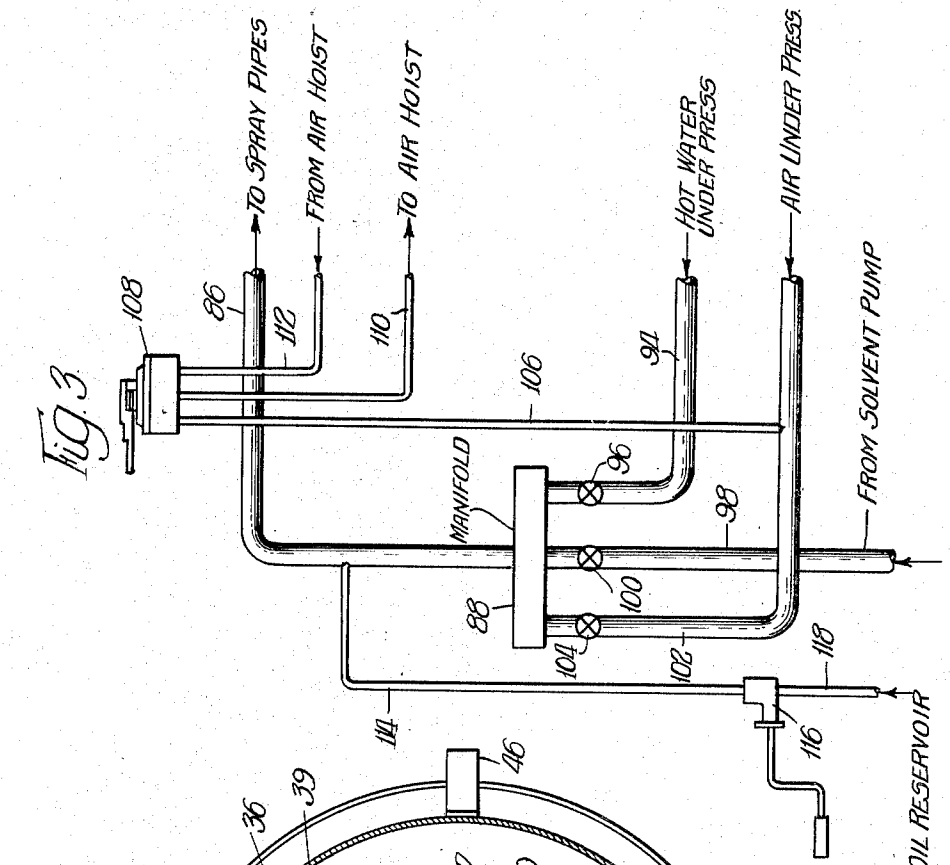


Fig. 3

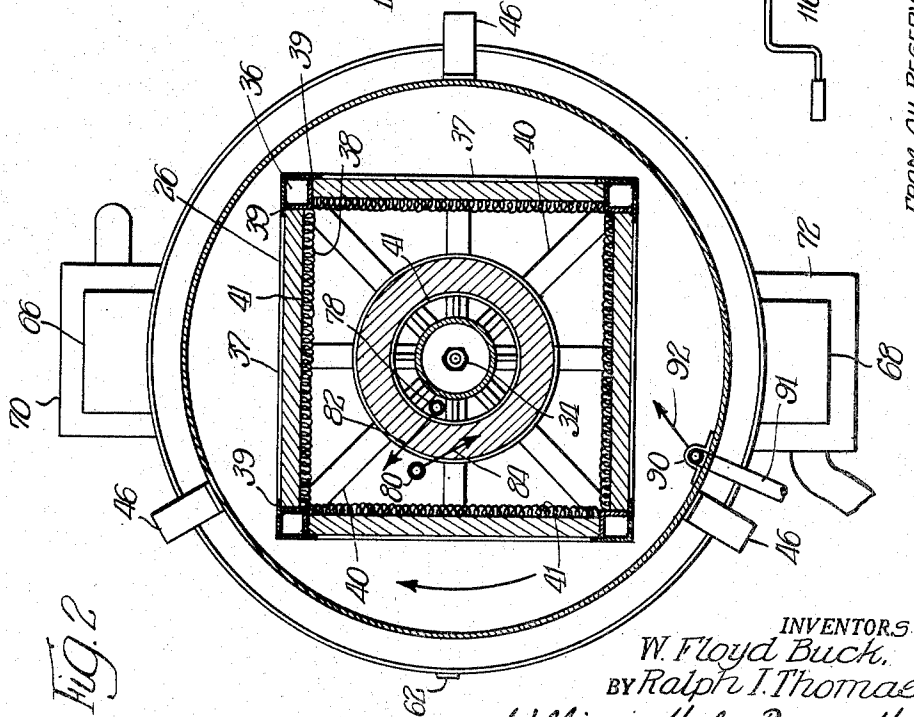


Fig. 2

INVENTORS.
W. Floyd Buck,
BY Ralph I. Thomas,
Wilkinson, Huxley, Byron, & Hume
Attys

United States Patent Office 2,699,793 Patented Jan. 18, 1955

2,699,793

CENTRIFUGAL CLEANER FOR AIR FILTERS

W. Floyd Buck and Ralph I. Thomas, Lincoln, Nebr., assignors to a partnership composed of said Buck, said Thomas, Henry H. Urbach, Evanston, Ill., and Charles E. Melker, Lincoln, Nebr.

Application October 4, 1949, Serial No. 119,548

3 Claims. (Cl. 134—143)

This invention relates to a process for cleaning filters and apparatus therefor. More particularly, it relates to a process and apparatus for cleaning filters which are substantially flat or cylindrical, such as the air filters currently used on diesel locomotives.

Previously used methods of cleaning filters of this type, whether of the substantially flat or cylindrical form, have required three separate containers, a bake oven and overhead hoists. In addition, the cleaning operation, up until now, has consumed about 6 hours per filter. The present process and apparatus which are the subject of this application permit the cleaning and oiling of filters of the general type described, in a single container and in a plurality of steps requiring a total of approximately 2 minutes per filter.

This new and improved process comprises disposing such filters symmetrically about a common axis of rotation, the flat filters being disposed with their intake sides out substantially parallel to this axis and the cylindrical filters being disposed so that the longitudinal axis thereof is coincident with this axis of rotation. When so disposed, the filters are then rotated as a unit about the axis of rotation at a relatively high speed, and while being so rotated are brought into association with a plurality of liquid and gaseous agents under pressure.

The actual cleaning steps which have been found to be preferable in the carrying out of this process while the filters are being rotated as described within a suitable housing are: (1) washing the filters with water substantially at the boiling point; (2) washing with a suitable hot solvent, such as a caustic cleaner and water; (3) rinsing with hot water substantially at the boiling point; (4) blowing off and/or drying all remaining liquid with compressed air; (5) spraying with a light oil; and (6) blowing off surplus oil with compressed air.

It is therefore an object of this invention to provide a process and apparatus which will permit the rapid cleaning of a plurality of filters both of substantially flat and cylindrical form in a single container by the rapid rotation of said filters and the simultaneous application in the proper sequence of various liquids thereto in the form of a plurality of very thin streams.

It is a further object to provide a process and apparatus of the character described which will accommodate a plurality of substantially flat filters at the same time, and which will permit the use of a desirable centrifugal action in conjunction with a spraying action on both cylindrical and substantially flat filters.

Another object to provide an apparatus which permits the various steps necessary for thorough cleaning of filters to be carried out in the same container, and which also permits the introduction of the various fluids utilized into this single container through a common manifold.

Still another object is to provide such a process and apparatus which will enable the recovery of certain of the liquids so that they may be recycled.

Further objects and advantages of this invention will become evident as the description proceeds and from an examination of the accompanying drawings which illustrate one embodiment of the invention and in which similar numerals refer to similar parts throughout the several views.

In the drawings:

Figure 1 is a side elevation partly in vertical cross-section of one form of apparatus embodying the invention;

Figure 2 is a horizontal sectional view, from above, of the main portion of the apparatus shown in Figure 1, the section being taken along line 2—2 of that figure; and

Figure 3 is a somewhat diagrammatical representation of the manifold, oil pump and hoist control valve which are normally associated with the apparatus shown in Figure 1.

Referring now to Figures 1 and 2, the main components of the apparatus may be mounted on the steel metal plate 10. The electric motor 12 may be used as the prime mover for the apparatus, having a shaft 14 extending therefrom with a clutch member 16 disposed between shaft 14 and shaft 18, which is longitudinally aligned with shaft 14. The shaft 18 may be provided with a braking mechanism 20, if so desired. The gear housing 22 is also mounted on the base plate 10, and contains suitable gears for transmitting the power from the horizontal shaft 18 to the vertical shaft 24. The shaft 24 has a filter basket 26 mounted thereon which may have a substantially square shape, as best shown in Figure 2. The filter basket has a cylindrical central core 28 extending upwardly from the bottom thereof which contains a collar member 30 having a central opening therein adapted to receive the tapered upper end 32 of the vertical shaft 24. The upper extremity of the shaft 24 is threaded and adapted to receive the locking nut 34 which secures the filter basket 26 to the vertical shaft 24. The filter basket 26 disclosed is to be rotated in a clockwise direction, as shown by the arrow in Figure 2. The filter basket 26 has a relatively open structure and may be formed so as to support any number of substantially flat filters about and substantially parallel to its axis of rotation. One of the simplest forms it may take is that which is shown in Figures 1 and 2, namely, that of an open-sided square adapted to receive a single flat filter or a plurality of flat filters on each side thereof, so that the filters are held in a box-like arrangement with an open top and a substantially open bottom. Each of the corners of the filter basket may have a vertical post 36 disposed thereon with suitable bracing 37 extending between the outside edges of adjacent posts to form, together with the vertical projecting flanges 39 on each side of each post 36, the means for retaining the flat filters within the basket as the latter is rotated. Suitable means for causing the substantially flat filters to retain the appropriate position in the filter basket when the basket is not rotating may also be provided, such as the spring members 38, which extend between the inner corners of adjacent vertical corner posts. Both the bracing members extending between the outside edges of the vertical corner posts 36 and the retaining members, such as springs 38 extending between the inside corners of adjacent corner posts, may be designed in such a way as to provide support for either a single large flat filter or a plurality of smaller flat filters fitted together to form an area which is substantially the same as the area of one side of the basket between the vertical corner posts. Two smaller filters are shown in position on the left hand side of the basket, as shown in Figure 1, for example.

As best shown in Figure 2, the bottom portion of the filter basket may be made up of a plurality of symmetrically disposed radial struts 40 adapted to support the outer framework of the basket and yet providing a substantially open bottom. As shown in Figures 1 and 2, a collar 41 is centrally mounted in the base of the filter basket and is adapted to be inserted in one end of the cylindrical filters, such as the filter 42, shown in Figures 1 and 2, when they are slipped over the central core 28 of the filter basket.

A cylindrical housing 44 is provided which encompasses the filter basket 26 and is open at the top and bottom. The housing 44 is supported in this position by a plurality of legs 46 which may be offset, as shown in Figure 1, to provide room for the drain pan 48. This pan in turn is pivotally mounted on the rods 50 and 52, so that it encompasses the bottom portion of the housing 44. The rod 50 is mounted at one end of the housing 54 of the shaft 24, and at the other end on one of the supporting legs 56. The rod 52 is longitudinally aligned with the rod 50 and is also mounted at one end on the housing 54 and at the opposite end on the housing 56, which encloses the electric motor and its related components.

The circular pan **48** has a center opening **58** therein through which the housing **54** is adapted to extend, the cylindrical collar **60** around the opening **58** being of sufficient height to extend up into the center core **28** of the basket **26**. This arrangement enables the drain pan **48** to be tilted about the axis formed by the rods **50** and **52** by operation of the control lever **62** secured to the vertical wall **64** forming the outer periphery of the pan **48**. The two drain spouts **66** and **68** may be formed integrally with the side wall **64** of the pan **48** so that they are disposed diametrically opposite to each other on a line substantially perpendicular to the rods **50** and **52**. The drain spout **66** may have associated therewith the drain **70**, which may, in turn, be in communication with a sewer or other means of disposal, while the drain spout **68** may have associated therewith the drain **72**, in communication with the solvent reservoir. This arrangement permits the drain pan to be tilted so that the contents thereof will drain either into the drain **70** or the drain **72**, as desired. When the filters are being washed with hot water, the pan is generally tilted so as to drain through the drain spout **66**, whereas when the solvent is being used, the pan is generally tilted in the opposite direction, so that the pan will drain through the drain spout **68** and the drain **72**, and the solvent will be returned to the storage tank.

The housing lid **74** may be supported by the overhead air hoist **76**, so that it may be conveniently raised or lowered to allow the filters to be disposed in or removed from the filter basket. The nozzles or spray pipes **78** and **80** are supported by the housing lid **74** in such a way as to extend vertically down into the filter basket. The spray pipe **78** is disposed so that it will be positioned between what would be the outer surface of a circular filter when mounted in the filter basket and the inner surface of the substantially flat filters mounted in the filter basket as previously described. The spray pipe **80** is mounted between the center core **28** of the filter basket **26** and the inner surface of a cylindrical filter when mounted in the filter basket, as shown and described. Each of these spray pipes is closed at its lower extremity, and has a vertical line of small orifices formed therein, each of which are adapted to direct a thin stream of liquid at the filters, as indicated by the arrows **82** and **84**. The upper extremities of these two spray pipes are in communication with a flexible portion of the conduit **86**, which conduit is in turn connected to a manifold **88**, as shown in Figure 3.

A third spray pipe **90** of substantially the same character as the two previously described is mounted on the interior of the housing **44**, and is adapted to direct a plurality of small streams of liquid in the direction of the arrow **92**. This spray pipe is also connected to the conduit **86** through the pipe **91**.

Referring now to Figure 3, the manifold **88** and its associated conduits are there shown somewhat diagrammatically. The pipe **94** is in communication with the manifold at one end and is connected at its opposite end to a source of hot water under pressure. It also has the valve **96** disposed therein, adjacent the manifold, for selectively controlling the input of hot water to the manifold. A pressure of 120 pounds per square inch has been found satisfactory for the hot water. The pipe **98** is also in communication with the manifold **88**, and its opposite end is connected to a pump (not shown), which is in turn connected to a sump (also not shown), which may be located in any convenient position, such as below the drain pan **48**. The input of the solvent to the manifold may be controlled by the valve **100** in the pipe **98**. A solvent pump developing a pressure of 35 pounds per square inch has been used successfully. The pipe **102** is also in communication with the manifold **98**, and at its opposite end is connected to a source of compressed air. The valve **104** in the pipe **102** is used to control the input of compressed air to the manifold **88**.

The pipe **102** may also have the pipe **106** connected thereto providing a source of compressed air for the operation of the overhead air hoist **76**. The pipe **106** is in communication with the hoist control valve **108**, which in turn controls the operation of the hoist through the pipes **110** and **112**. The conduit **86** extending between the manifold **88** and the spray pipes **78** and **80** may have the pipe **114** in communication therewith which in turn is connected to a high pressure oil pump **116**. The pipe **118** extends between the oil pump **116** and an oil reservoir (not shown).

It should be understood that either the substantially flat type filters or the cylindrical type filters may be cleaned in this apparatus, but the simultaneous cleaning of both types of filters is not practical in the apparatus shown in the drawings. To clean the substantially flat type filters which, for example, are of a size approximately equal to one side of the filter basket, the following steps are employed. The housing lid member **74** is lifted out of association with the housing **44** by operation of the overhead hoist **76**. One of such filters is then disposed with its inner side out in each side of the filter basket between two of the vertical corner posts so that it abuts the outer frame members **37** extending between these corner posts and the flanges **39**, and is held in this position by the spring members **38**. The four filters will then form a box-like unit open at the top and bottom, as best shown in Figure 2. The hoist control valve **108** may then be operated to lower the housing lid member **74** into the position shown in Figure 1, which in turn will cause the spray pipes **78** and **80** to also assume the position shown in this figure. The clutch member **16** is then engaged so that the shaft **24** is rotated at a relatively high speed, which in turn causes the filter basket **26** to rotate in the same fashion. After the basket has attained the desired speed (300 revolutions per minute has been found to be satisfactory), the valve **96** may be opened so that hot water is sprayed from all three of the spray pipes **78**, **80** and **90**, in the direction of the arrows **82**, **84** and **92** respectively. In washing air filters from a diesel locomotive, this washing step may be continued for approximately 15 seconds. The valve **96** is then closed, and the valve **100** opened so that the rapidly rotating filters are then sprayed with a suitable solvent, which spray may also be continued for a period of approximately 15 seconds. Valve **100** is then closed and valve **96** again opened for a 15 second rinse with hot water.

Following this operation, valve **96** is again closed and valve **104** is opened so that the spray pipes then direct a stream of compressed air against the rotating filters. This operation will cause the filters to become completely dry in a period of approximately 15 seconds, and at the end of this period of time the oil pump **116** may be operated for a period sufficient to inject the required amount of oil into the pipe **86** carrying the compressed air. The filters are thus given a light coating of suitable oil. After the operation of the pump **116** is discontinued, the blast of the compressed air from the perforated pipes is continued for a short period in order to blow off any surplus oil which may remain on the filters over and above that amount which is desirable for proper operation of the cleaned filter. During all of these various operations, the filter basket has been continuously rotated at a relatively high speed, but after the surplus oil is blown off the clutch **16** may be disengaged, and the brake **23** operated. The frame lid **74** may then be raised and the cleaned filters removed to make way for a repetition of the process on a new batch of filters.

During the first washing step, in which a rather high percentage of the foreign material is removed from the filter, the drain pan **48** may be tilted by operation of the control member **62** so that the drain spout **66** is brought into close association with the drain **70** and the hot water containing the dirt and other undesirable material is disposed of as waste through this latter drain. Prior to beginning the application of the hot solvent, however, the drain pan **48** is tilted in the opposite direction by operation of the control member **62**, so that the operation of the drain spout **68** is brought into close association with the drain **72** and the solvent is thus returned to the sump from which it was initially drawn by the solvent pump. Again prior to the rinsing step, the drain pan **48** may be returned to the position in which the drain spout **66** is brought into close association with the drain **70**, and the rinse water may then be passed off as waste material.

Although the various liquids are projected from the spray pipes with considerable force, it has been noted from the actual operation of the apparatus disclosed that the centrifugal force generated by the relatively rapid rotation of the filters is such that it contributes greatly to the cleaning action of the liquids utilized. Assuming a clockwise rotation of the filter basket **26**, as viewed in Figure 2, although the spray pipes **79** and **80** are arranged

so as to project the streams of liquid in a way which does not substantially oppose the centrifugal forces generated, the spray pipe **90** is shown disposed so as to spray in a direction substantially contrary to that in which the centrifugal force will tend to throw fluid material once it is in association with the rapidly rotating filters. This disposition of the spray pipe **90** has been found to be advantageous, since its primary purpose is to aid in removing the undesirable material from the outer face of the filter as it is forced out from the interior of the filter by the action of the spray pipes **78** and **80**, and also by the centrifugal force generated by the rotation of the filters.

As previously stated, the entire cleaning operation which previously consumed about 6 hours per filter can now be carried out utilizing this apparatus so that approximately 2 minutes per filter is required. This results, of course, in a very substantial saving, and, in the case of locomotive filters, also eliminates the necessity for keeping a spare set of filters on hand with which to replace those which are being cleaned. In other words, the time for cleaning has been so reduced that the operation can be carried out in the normal time allowed for reconditioning the locomotive when it is not actually being taken out of operation for overhauling.

With respect to the cleaning of cylindrical filters, the process is substantially the same as described for the cleaning of the substantially flat filters. One end of the cylindrical filter is disposed on the collar **41**, and during the cleaning steps the spray pipes **78** and **80** function in substantially the same way as the spray pipes **78** and **90** function respectively during the cleaning of the flat filters. A valve may be provided for shutting off the spray pipe **90** during the cleaning of cylindrical filters if desired, since it will contribute very little to the operation. The same sequence of steps is followed in the cleaning of a cylindrical filter as described above, and the results achieved are equally as desirable.

The drawing and the above discussion are not intended to represent the only possible form of this invention, in regard to details of construction. Changes in form and in the proportion of parts, as well as the substitution of equivalents are contemplated, as circumstances may suggest or render expedient, without departing from the spirit or scope of this invention, as further defined in the following claims.

What is claimed is:

1. A filter cleaning device comprising a rotatable basket, said basket being adapted to hold a plurality of substantially flat filters in abutting relationship with the sides of said basket by means of centrifugal force when said basket is rotated, means for rotating said basket, said basket being mounted on said means, a forked supply pipe disposed in substantially parallel relationship to the axis of rotation of said basket, a plurality of spraying means in the forks of said pipe adapted to project filter cleaning elements against said filters at substantially a right angle to the vertical plane of said filters, an enclosing shield for said basket and said spray means, a manually tiltable receptacle enclosing the base of said shield having a drain

opening on each side of the axis about which said receptacle tilts.

2. A filter cleaning device comprising an externally braced upright basket member of substantially open construction centrally mounted at its base on a rotatable supporting axis, said axis being adapted to be activated at one end thereof, said basket member being adapted to support a plurality of symmetrically disposed substantially flat filters each substantially normal to a radial line extending from said supporting axis, a single non-rotatable enclosing chamber for said basket, a supply pipe disposed in substantially perpendicular relationship to the top of said chamber, and a plurality of directional spray pipes branching from said supply pipe and disposed substantially parallel to the axis of rotation of said basket member within said basket member adapted to spray liquid and gaseous substances as desired against the inner surfaces of said filters at substantially a right angle to the vertical planes thereof under substantial pressure so that the passage of said liquid and gaseous substances through said filters is insured by the operation of centrifugal force, and a manually tiltable receptacle at the base of said housing for collecting and selectively distributing said fluid substances.

3. A filter cleaning device comprising an externally braced upright basket member of substantially open construction centrally mounted at its base on a rotatable supporting axis, said axis being adapted to be activated at one end thereof, said basket member being adapted to support a plurality of symmetrically disposed substantially flat filters each substantially normal to a radial line extending from said supporting axis, a single non-rotatable enclosing chamber for said basket, a supply pipe disposed in substantially perpendicular relationship to the top of said chamber, and a plurality of directional spray pipes branching from said supply pipe and disposed substantially parallel to the axis of rotation of said basket member within said basket member adapted to spray liquid and gaseous substances as desired against the inner surfaces of said filters at substantially a right angle to the vertical planes thereof under substantial pressure so that the passage of said liquid and gaseous substances through said filters is insured by the operation of centrifugal force, and a manually tiltable receptacle enclosing the base of said housing member having a drain opening on each side of the axis about which said receptacle tilts.

References Cited in the file of this patent

UNITED STATES PATENTS

1,197,324	Wright	Sept. 5, 1916
1,405,243	Wing	Jan. 31, 1922
1,435,172	Masonick	Nov. 14, 1922
1,670,611	Couch	May 22, 1928
1,712,751	Cunningham	May 14, 1929
2,178,701	Petre	Nov. 7, 1939
2,249,521	Graham et al.	July 15, 1941
2,256,663	Brewer	Sept. 23, 1941
2,508,999	Hirsch	May 23, 1950