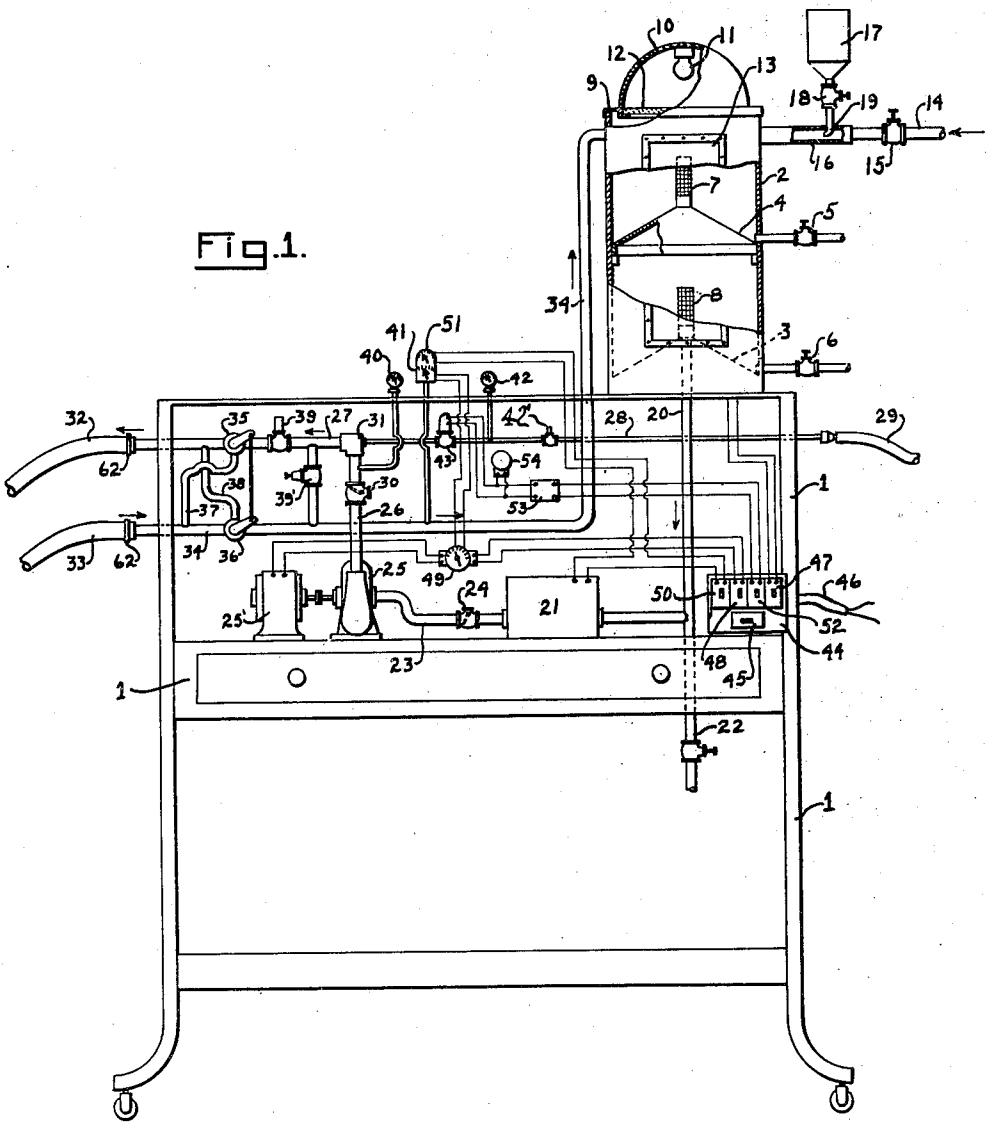
Nov. 19, 1940. W. T. POWELL ET AL 2,222,516

METHOD AND APPARATUS FOR CLEANING FLUID CIRCULATING SYSTEMS

Filed July 21, 1937 2 Sheets-Sheet 1

Fig. 1.



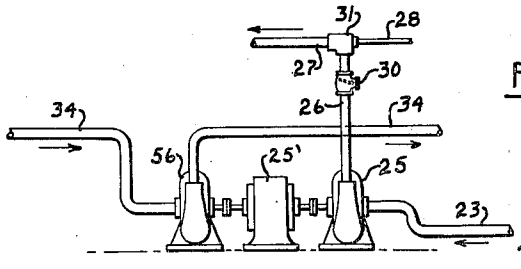


Fig. 2.

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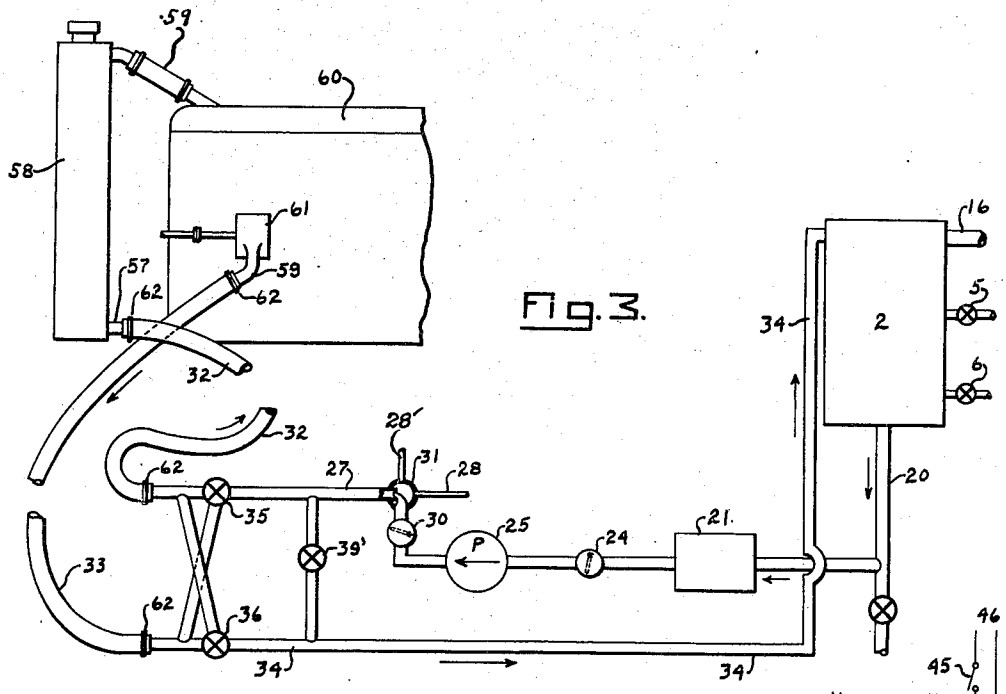

Fig. 3.

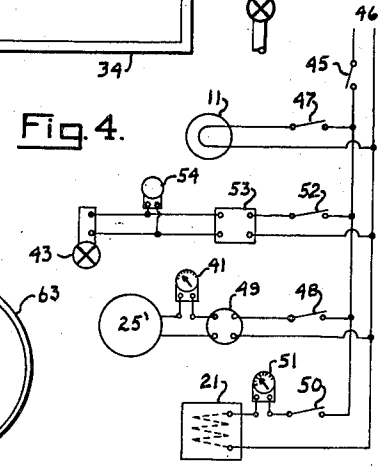

Fig. 4.

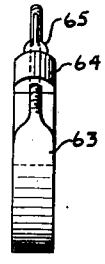

Fig. 5.

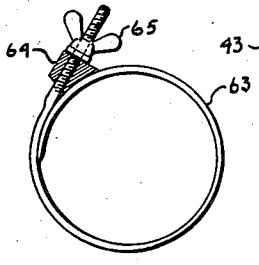

Fig. 6.

Fig. 7.

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METHOD AND APPARATUS FOR CLEANING FLUID CIRCULATING SYSTEMS

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Application July 21, 1937, Serial No. 154,872

20 Claims. (Cl. 141—1)

The present invention relates to a method and apparatus for cleaning fluid-circulation systems and the like and particularly for cleaning and reconditioning the cooling systems of automobiles.

The invention may be fully understood from the following description read in conjunction with the accompanying drawings in which

Fig. 1 is a side elevation partly in section of the complete apparatus.

Fig. 2 is a side elevation of a portion of such apparatus showing the location of a supplementary pump.

Fig. 3 is a schematic layout of the apparatus showing its connection to an automobile cooling system.

Fig. 4 is a diagrammatic layout of the electrical circuits used for control and regulation.

Fig. 5 is an end view of a special hose clamp as used in this device.

Fig. 6 is a side view partly in section of such a clamp; and

Fig. 7 is side view of the clamp before use.

Referring now to the drawings, in Fig. 1 numeral 1 designates a carrier stand for the apparatus which may be provided, as with casters, for portable use. For the purpose of illustration the stand is shown as of skeleton structure but it may be of any convenient shape, enclosed or not as desired.

A vessel 2, carried by the stand, serves as a receptacle or reservoir for fresh cleaning fluid entering the system and as a separator for the used fluid. The vessel as shown is provided with substantially conical base plate 3 and removable partition 4, in each of which the base line is inclined slightly to provide for drainage toward valved pipes 5 and 6 respectively. The plate 3 and partition 4 each have a central opening in which is disposed a strainer or filter element as at 7 and 8. The vessel is provided with a separable cover 9 which may be domed as at 10 to house a lamp 11 lighting the interior of the vessel through a glass covered port 12, in which case a glass covered inspection port 13 should be provided in at least one side of the vessel.

A cleaning fluid, such as water, is supplied to the vessel by means of pipe 14 provided with a valve 15 and usually with a means such as a water jet eductor device for drawing into the moving stream of fluid a solvent material in either dry or solution form. Such an arrangement is shown at 16 where a container 17 is adapted to supply a solvent material through valve 18 and pipe 19.

A pipe 20 is connected to the opening in base plate 3 and to a heater 21 with a valved branch pipe 22 to provide additional drainage for the system. A pipe 23 provided with a check valve 24 connects the heater to the suction side of a pump 25 driven by a motor 25^1. A pipe 26 delivers cleaning fluid under pressure of the pump to a pipe 27 to which is connected an air line 28 connected to a source of air under superatmospheric pressure by means of a hose 29. A check valve 30 is disposed in the line 26 to prevent binding of the pump when using air under superatmospheric pressure. If desired the pipe 26 may deliver cleaning fluid to the pipe 27 through an eductor device 31 to which the air line 28 may be connected. Also if desired, air from the atmosphere and at atmospheric pressure may be drawn in through pipe line 28 under the induced pressure of the stream of cleaning fluid simply by removing hose 29 from the end of line 28. Suitable hose connections 32 and 33 are secured to pipes 27 and 34 respectively. Since the apparatus is portable it may be brought to the side of the system to be cleaned and quickly attached thereto by hoses 32 and 33.

In order to permit a sudden and rapid reversal of flow through the system to be cleaned, two-way rapid action valves 35 and 36 are provided in the lines 27 and 34 respectively with interconnecting lines 37 and 38 providing the conduits for changing the direction of flow in the lines 34 and 27. These valves are interconnected for simultaneous action and may be operated automatically by a suitable actuating device if desired. In addition a relief valve 39 is provided in the line 27 to relieve any air which may be trapped in the system. A pressure relief valve 39^1 connected to lines 27 and 34 is provided to prevent excessive pressure in the system and will operate to permit the passing of a portion of the liquid from the line 27 into the line 34 leading to the vessel 2.

Various indicating, regulating and other control devices complete the apparatus as shown and include a pressure gauge 40 connected to the line 26 from the pump 25, a combined pressure and temperature gauge-control 41 connected into the line 34, and an air pressure gauge 42 and relief valve 42' in the air line 28. An electrically operated valve 43 controls the flow of air through the eductor 31.

The automatic operation of the apparatus is obtained by means of electric controls connected to the apparatus in the following manner and shown diagrammatically in both Figs. 1 and 4.

A switch box 44 controlled by master switch 45 and receiving current through the cord 46 contains: a switch 47 controlling the circuit for the dome light 11; a switch 48 controlling the circuit for the motor 25¹, in which circuit there is connected in series a timing device 49 and the pressure control 41; a switch 50 controlling the circuit for the heater, in which circuit there is connected in series a water temperature control 51; and a switch 52 controlling the circuit to the electrically operated air control valve 43 in which circuit is connected in series an intermittent circuit breaker 53 and a signal device such as bell 54.

In Fig. 2 is shown an alternate arrangement according to which a pump 56, also driven by the motor 25¹, is connected in the line 34 so as to increase the velocity of the fluid passing through the circulation system being cleaned by placing suction on the line 34 through which liquid is drawn from the system.

In Figure 3 the invention is illustrated in operation while cleaning the water circulating system of an automobile whose engine 60 is here shown as provided with a water circulating pump 61 which is normally connected to outlet 57 at the bottom of radiator 58. A suitable hose connection 59' is provided between the engine and the inlet at the top of the radiator so that, in normal operation, water is forced by pump 61 through the engine cooling passages and hose 59' into the top of radiator 58. After cooling in the radiator, water is normally led back to pump 61 through a suitable hose connection (not shown) between outlet 57 and inlet 59 at the pump.

However, in Figure 3, hose 32 is attached to outlet 57 and hose 33 is attached to inlet 59. Obviously if it was desired to clean the radiator 58 only, hose 59' could be removed and hose 33 could be attached to the top of the radiator in its place. Preferably, however, the whole fluid circulating system of the engine should be cleaned and the arrangement illustrated in Figure 3 is designed to attain this result. Furthermore the engine is preferably operating in a normal manner while its circulating system is being cleaned.

A suitable quantity of cleaning fluid, which may be water or a solution containing solvents for reacting chemically with the foreign matter in the system, is introduced into the system by way of the radiator cap, or more preferably through pipe 14 into reservoir 2. If desired reservoir 2 may be filled by removing cover 9 and pouring the fluid in from the top. The transparent inspection port 13 enables the operator to tell approximately how much cleaning fluid is in the system, the condition of that fluid and whether there is need for more to be added during the cleaning operation.

Line switch 45 is closed and then switch 48 is closed to start pump 25 for circulating the cleaning fluid through the system. The cleaning fluid passes in what might be termed a closed or complete circuit. Starting from reservoir 2 the cleaning fluid passes through pipes 20, 23 and 27 to hose connection 32. From hose 32 the cleaning fluid enters the radiator through outlet 57, travels upwardly through the radiator in a direction opposite to normal flow, outwardly through hose 59', through the engine cooling passages to pump 61 and into hose connection 33. From hose 33 the cleaning fluid enters pipe 34 from which it discharges into the top of reservoir 2. Rust particles and other foreign materials are here removed from the cleaning fluid by passing it through strainers 7 and 8 in succession before again allowing it to re-enter pipe 20 to be recirculated through the same closed circuit.

It will be understood that the term "complete circuit" is not restricted to a closed fluid conduit or the like, but is used simply to denote a circuit which contains the cleaning fluid at all times during its successive circulations to permit substantially uninterrupted repeated circulation of the cleaning fluid over a long period of time.

The engine is normally in operation during the cleaning operation and the heat therefrom is sufficient to maintain the circulating cleaning fluid at a temperature high enough for all practical cleaning purposes. Heater 21 may be energized by closing switch 50 to get additional heat if more is needed but such is ordinarily not necessary.

Cleaning action of the circulating cleaning fluid is tremendously increased by introducing a suitable fluid under pressure into the cleaning fluid stream at 31 to cause turbulence therein. This fluid may be of any suitable nature, but preferably air under superatmospheric pressure is used since air pressure hoses are available in nearly all garages. Air may be introduced into the cleaning fluid stream in a continuous stream, but preferably it is intermittently introduced and this is accomplished by means of the electrically operated valve 43 in line 28.

Valve 43 is of a conventional type and its control circuit is energized by closing switch 52 in Figure 4. The control circuit includes an intermittent circuit breaker 53, which may include a heat sensitive resistance element adapted to break the circuit at regular and frequent intervals. This causes the valve 43 to open and close instantaneously at those intervals to admit sudden spurts of air through eductor 31 into the cleaning fluid stream in pipe 27. Air admitted in this manner causes water hammer and imparts vibratory shocks to the fluid in the system which loosens and breaks down badly encrusted deposits and permits effective contact of the cleaning and solvent fluid.

When air under relatively high pressure is admitted intermittently into the cleaning fluid stream the effect of such is to cause alternate charges of cleaning fluid and air to surge through the system thereby giving the combined advantages of liquid and air blast cleaning during the same operation.

Progress of the cleaning operation may be observed by looking through window 13 at the circulating cleaning fluid. If a radiator is exceptionally dirty the reservoir 2 may be drained and cleaned by means of pipes 5 and 6 several times during the operation, fresh cleaning fluid being added to replace that withdrawn.

An auxiliary air inlet pipe 28' may be provided, if desired, to permit air to be drawn in from the atmosphere regardless of the manner in which air is supplied at line 28.

The clamps 62 used on hoses 32 and 33 in conjunction with the apparatus previously described are especially adapted to provide a pressure resistant connection between the hose portions 32 and 33 and the rigid pipes to which they are required to be joined. The clamp 62 as illustrated in Figs. 5, 6 and 7 consist of a flexible rod 63 threaded for a portion of one end and flattened for the remainder of its length and tapered at the end. Secured to the upper surface of the flattened portion, in spaced relation to the end thereof is a lug 64 having a passageway whose axis lies in the same plane with the center line of the

rod and is tangent to the circular outline of the clamp, when bent to encircle a tubular article, to permit insertion of the threaded end of the rod to such extent as may be necessary to permit engagement thereof by a wing nut **65** adapted to accomplish contraction of the circle formed by the clamp and thereby establish the pressure tight connection required.

The water temperature control **51** regulating the heater **21** may be used to maintain the cleaning liquid at the temperature best suited for the operation but during such operation, because of the continuous flow of fluid through the motor and radiator, it is possible to operate the motor at idling speed or above so as to produce all or the greater portion of such heat as may be required and heater **21** need not be used as explained above. The pressure of pump **25** should be sufficient to overcome the resistance of the pump **61** on the motor **60**.

Further aid to the effectiveness of the procedure is accomplished by means of the provision for sudden and complete reversal of flow through the circulation system. As described above this is done without interfering with either the normal operation of the pumps or with the flow of fluid through the chamber **2**.

Although many advantages will be apparent upon consideration of the method and apparatus described above, it will be noted that chief among them will be the possibility of carrying out a cleaning operation with only a slight interruption of the normal use of the motor or apparatus whose circulation system is to be cleaned. This is of particular importance in the case of stationary internal combustion engines used to drive generators, pumps and the like where interruption of service is an important factor; the use of the impact action of intermittently supplied air; and the reversed and reversible passage of cleaning fluid within the circulation system. Also by provision of an automatic timing device and a signal the apparatus may be placed in operation with the timer set for a predetermined period and left unattended while the operator attends to other duties. When the predetermined cleaning has been terminated the fact will be indicated by cessation of the intermittent signal.

A metering device may be provided (not shown) to tell the number of gallons of liquid per given time circulated during the cleaning operation. This flow meter, which can be of any desired type, may be inserted in the pipe line **34** at a convenient point. A glance at this flow meter will indicate to the operator at once the progress of the cleaning action in the system since it is preferably calibrated with respect to the known rate of flow through a clean system.

The foregoing description is not to be understood as limiting, it being intended that such limitation shall only reside in the appended claims in which it is intended to claim all novelty for the invention as broadly as the prior art permits.

We claim:

1. A method of cleaning a fluid circulation system comprising passing a stream of cleaning fluid under pressure through a complete circuit including said system, imparting an initial stage of heat to said fluid prior to its introduction into the system, imparting a secondary stage of heat to said fluid and inducing turbulence thereof during its passage through the system, and removing a substantial portion of the foreign matter collected thereby during said passage.

2. A method of cleaning the fluid circulation system of an internal combustion engine comprising passing a stream of cleaning fluid under pressure through said system in a direction opposite to normal flow, imparting heat to said cleaning fluid during its passage through the system by operation of the engine in a normal manner, inducing turbulence in said stream of cleaning fluid by intermittent introduction of air and by intermittent reversal of the direction of flow, withdrawing a portion of the used cleaning fluid and foreign matter contained therein and supplying fresh cleaning fluid to the stream in an amount substantially corresponding to that withdrawn.

3. Apparatus for cleaning a fluid circulating system comprising means for continually forcing a stream of cleaning liquid under pressure through a complete circuit including said system and time controlled means for introducing a gaseous fluid at a pressure higher than said first-named pressure into said stream at frequent, successive intervals to impart a series of vibratory shocks in the same direction to said liquid.

4. In a method of cleaning a fluid circulating system, the steps of continually circulating hot cleaning fluid under pressure in a definite direction through a complete circuit including said system, and effecting intermittent surging of said fluid for predetermined periods of time at closely spaced successive timed intervals during passage of fluid through said system.

5. In a method of cleaning a fluid circulating system, the steps of continually circulating hot cleaning fluid under pressure in a definite direction through a complete circuit including said system, effecting intermittent surging of said fluid for predetermined periods of time at closely spaced successive timed intervals during passage of fluid through said system and removing a substantial portion of the foreign matter cleaned from said system from the fluid during said circulation.

6. Apparatus for cleaning a fluid circulating system which comprises means for continually passing cleaning fluid under pressure through a complete circuit including said system and means for periodically and at predetermined automatically timed intervals causing the rate of flow of said fluid to be greatly increased for predetermined periods of time.

7. In apparatus for cleaning a fluid circulating system; fluid handling apparatus including conduit means connected to said system to provide a complete circuit therewith; means in said apparatus for forcing cleaning fluid under pressure through said conduit means and said system; means for introducing air or a like gaseous fluid into said conduit means, said air being at a pressure higher than said first named pressure; a time controlled valve in said air introducing means; and a check valve in said conduit means, said time controlled valve being adapted to introduce charges of air into said conduit means at predetermined intervals to periodically accelerate the flow of cleaning fluid and said check valve being located to prevent said charges of air from forcing said cleaning fluid in reverse direction through said fluid forcing means.

8. A method of cleaning the fluid circulating system of an internal combustion engine which comprises circulating a stream of cleaning liquid under pressure through a complete circuit including said system while the engine is operating, and during said circulation withdrawing said used

fluid from said system, removing a substantial portion of the foreign matter therein and recirculating the fluid through the system, the heat derived from the running engine being utilized to maintain the cleaning liquid at a relatively high temperature during said circulation, and effecting turbulence of the fluid in said stream while passing through said system.

9. A method of cleaning the cooling fluid circulating system of an internal combustion engine which comprises passing a stream of cleaning fluid under pressure through said system in a direction opposite to normal flow of cooling fluid therein while the engine is operating, effecting turbulence of the fluid in said stream while passing through said system, withdrawing said used fluid from said system, removing a substantial portion of the foreign matter therein and recirculating the fluid through the system whereby the heat from the running engine will be utilized to maintain the cleaning fluid at a relatively high temperature.

10. Apparatus for cleaning a fluid circulating system comprising a reservoir adapted to be connected to the inlet and outlet portions of said system to provide a complete circuit for passage of cleaning liquid, means for forcing said liquid through said system under pressure and time controlled means for introducing fluid at a higher pressure than said liquid into said stream for causing periodic agitation of said cleaning liquid during passage through said system.

11. Apparatus for cleaning a fluid circulating system as defined in claim 10, said higher pressure fluid being applied adjacent the outlet of said reservoir and means preventing said higher pressure fluid from backing up into the reservoir.

12. Apparatus for cleaning a fluid circulating system comprising a portable support, a fluid container upstanding from the top of said support, means passing along the support for connecting said fluid container with the inlet and outlet portions of said system so as to provide a complete circuit through which a stream of cleaning fluid is to be passed, pump means on said support for forcing said cleaning fluid through said system, and time controlled means on said support for periodically introducing air under pressure into said stream between said pump and said system for causing intermittent agitation of the cleaning fluid during passage through said system.

13. A method of cleaning a liquid circulating system which comprises continually circulating cleaning fluid under pressure through a complete circuit including said system and introducing air under pressure into said cleaning liquid for a predetermined length of time at predetermined timed intervals to impart a plurality of successive vibratory shocks to the liquid in said system during said circulation.

14. In a method of cleaning the cooling fluid circulating system of an engine, the steps of passing a series of alternate timed charges of cleaning liquid and a gaseous fluid under pressure through said system while said engine is in operation.

15. In the method defined in claim 14, the direction of flow of the cleaning charges being opposite to normal fluid flow in the system.

16. The method of cleaning the cooling liquid circulating system of an internal combustion engine which comprises circulating cleaning fluid through said system in a direction reverse to normal flow while said engine is maintained in operation to effect heating of said fluid, and introducing timed charges of a gaseous fluid under pressure at predetermined timed intervals into said fluid to periodically increase the rate of flow of said fluid and thereby increase the mechanical cleaning action of said fluid.

17. Apparatus for cleaning a fluid circulating system comprising a reservoir adapted to be connected to the inlet and outlet portions of said system to provide a complete circuit for the passage of cleaning liquid, means for forcing said liquid through said system under pressure, time controlled means for introducing a gaseous fluid into said circuit between the reservoir and the system to be cleaned for causing periodic agitation of said cleaning fluid at predetermined timed intervals during passage through said system and a check valve in said circuit for preventing said gaseous fluid from interfering with normal operation of said forcing means.

18. Apparatus for cleaning a fluid circulating system comprising a pump, conduit means through which cleaning liquid is delivered from said pump to said system, time controlled means for introducing a gaseous fluid into said conduit means for causing periodic agitation of said cleaning fluid as it passes through said system and check valve means in said conduit means adjacent said pump for preventing said gaseous fluid from binding said pump.

19. In a method of cleaning the cooling liquid circulation system of an internal combustion engine wherein the cooling fluid flows in a given direction during normal operation of the engine, the step of forcing turbulent cleaning fluid through said system in a direction opposite to normal cooling liquid flow while maintaining said engine in otherwise normal operation.

20. Apparatus for cleaning a fluid circulating sysem comprising means for forcing a stream of cleaning fluid under pressure through a complete circuit including said system, time controlled means for frequently automatically increasing the pressure effective upon said stream for causing periodic violent agitation of said cleaning fluid as it passes through said system, and means for confining said pressure increases downstream of said first-named means.

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