

April 28, 1953

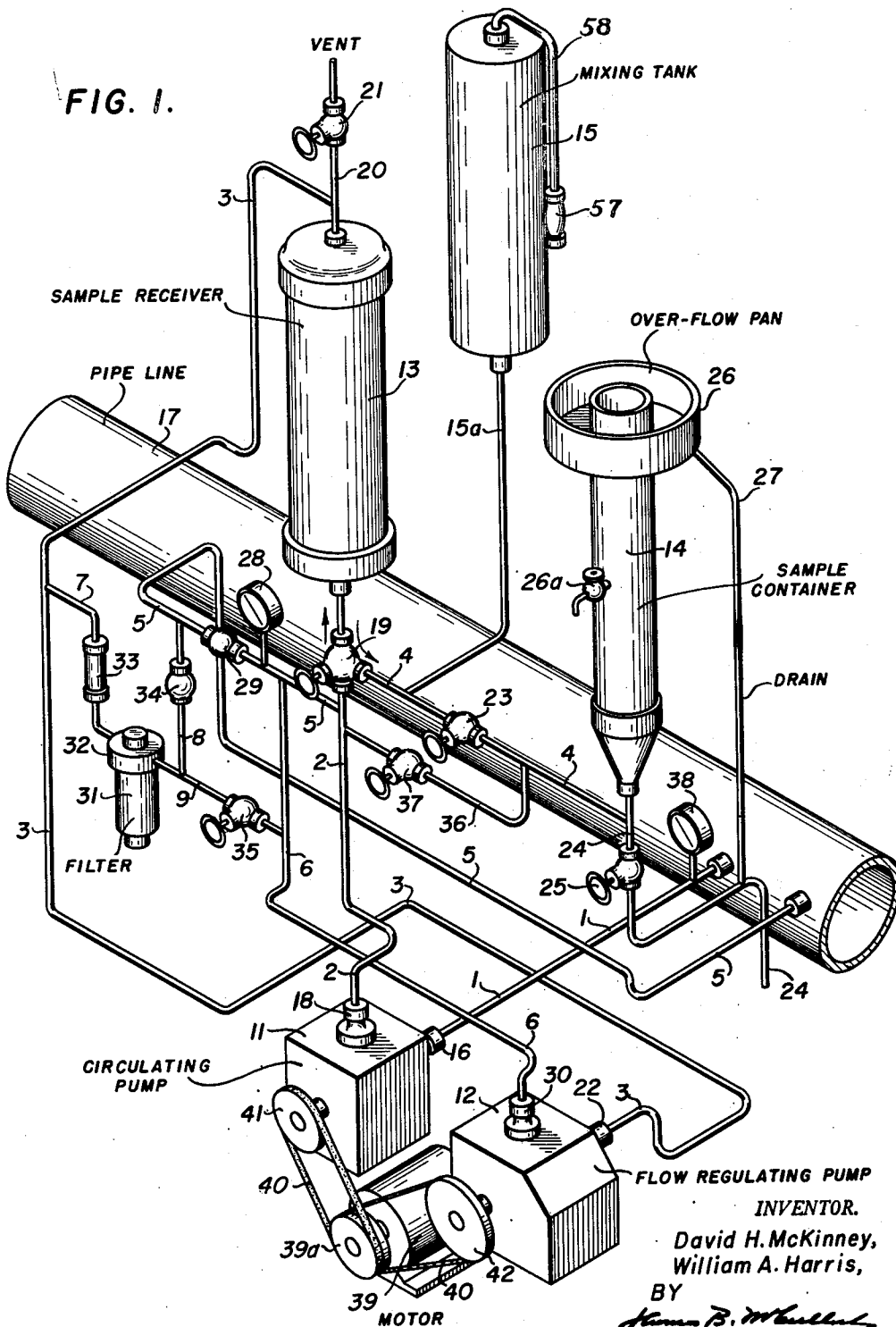
D. H. MCKINNEY ET AL

2,636,387

APPARATUS FOR SAMPLING FLOWING STREAMS

Filed July 19, 1951

2 SHEETS—SHEET 1



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2 SHEETS—SHEET 2

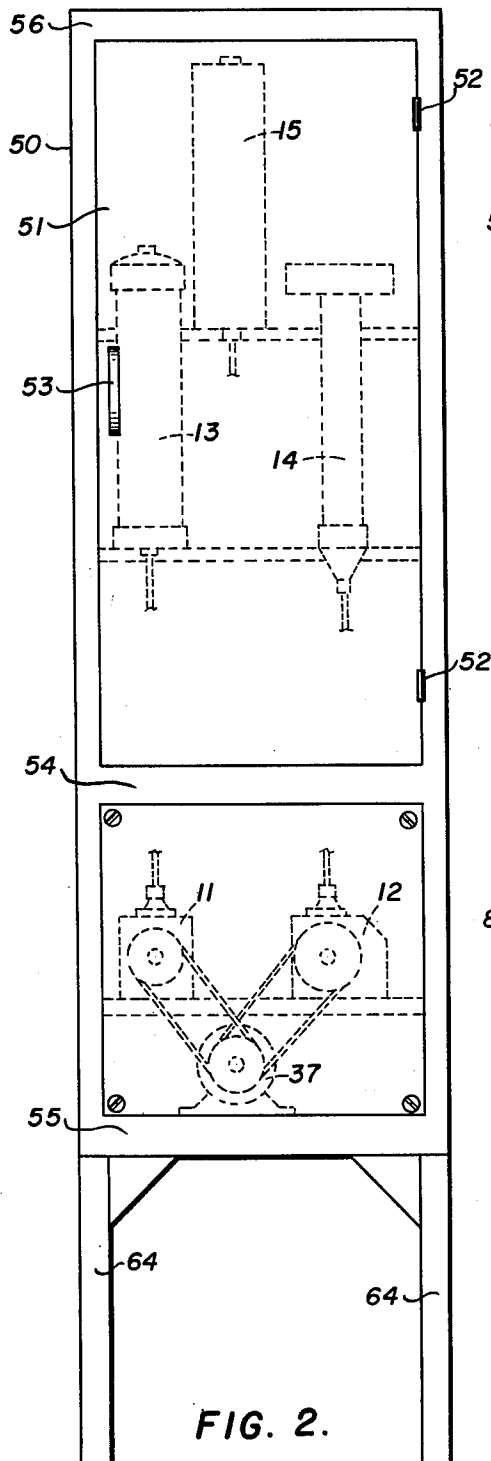


FIG. 2.

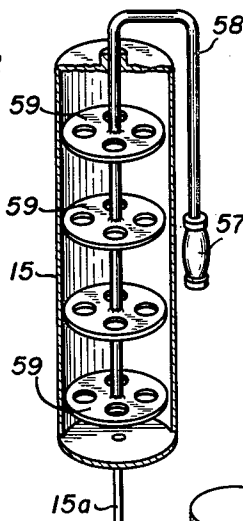


FIG. 4.

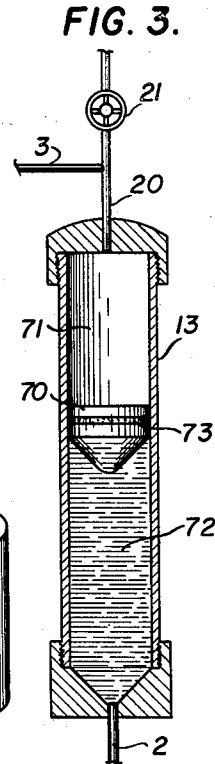


FIG. 3.

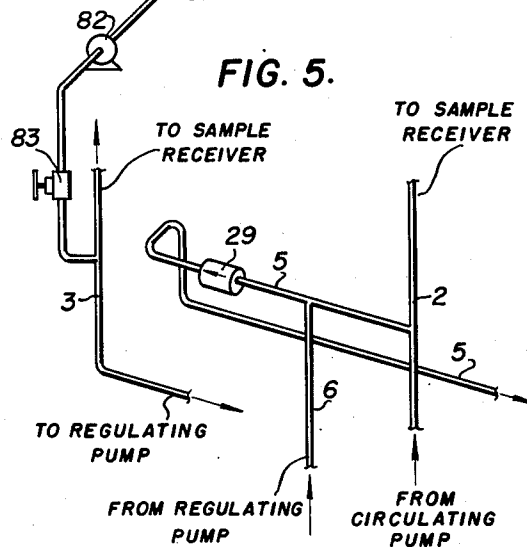


FIG. 5.

INVENTOR.
David H. McKinney,
BY William A. Harris,

Thomas B. McCall
AGENT.

UNITED STATES PATENT OFFICE

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APPARATUS FOR SAMPLING FLOWING STREAMS

David H. McKinney and William A. Harris, Houston, Tex., assignors, by mesne assignments, to Standard Oil Development Company, Elizabeth, N. J., a corporation of Delaware

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4 Claims. (Cl. 73-422)

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The present invention is directed to apparatus for obtaining a liquid sample from a flowing stream. More particularly, the invention is concerned with apparatus for obtaining samples from pipe lines in which liquid, such as gasoline, crude oil and the like, are being pumped under pressure.

The apparatus of the present invention may be described briefly as including, in combination, a circulating pump and a flow regulating pump, each having an intake port and a discharge port. A first conduit is connected to the intake port of the circulating pump and is adapted to be connected to the flowing stream which may be a high pressure pipe line in which crude oil is being pumped. The apparatus includes also a sample receiver having a piston member arranged therein which divides the sample receiver into upper and lower chambers; the volume of each of the chambers is changed as the position of the piston is changed. A second conduit connects the discharge port of the circulating pump to a lower end of the sample receiver while a third conduit connects the intake port of the flow regulating pump to an upper end of the sample receiver. A sample container is connected to the lower end of the sample receiver by a fourth conduit. A fifth conduit connects to the second conduit and in turn may be connected to discharge into the flowing stream. A sixth conduit connects to the discharge port of the flow regulating pump and to the fifth conduit. Injection means are provided for introducing a clean liquid into the sample receiver and into the upper chamber above the piston member.

The injection means may be made integral with the apparatus and may include a filtering means which will allow a portion of the liquid withdrawn from the flowing stream to provide the clean liquid for introduction into the upper end of the sample receiver.

It is also contemplated that a mixing means which may include a mixing tank with a mixing device arranged therein may be arranged between the sample receiver and the sample container. The mixing means allows the entire sample to be mixed to overcome any possible settling out of heavy components. The purpose of the mixing means is to allow one continuous sample to be taken for each batch of liquid being sampled during an entire period of pumping, or for each 24 hours. The receiver is emptied each 24 hours, or at end of pumping period.

It is contemplated that the apparatus includ-

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ing the several conduits will be provided with flow regulating means, such as valves and flow resisting means, such as check valves, which will allow flow of liquid in one direction on setting at a predetermined pressure and which will resist flow of liquid in another direction.

The invention will be further illustrated with reference to the drawing, in which

Fig. 1 is an isometric view of the apparatus of the present invention;

Fig. 2 is a side view of the apparatus showing it arranged in a housing therefor;

Fig. 3 is a sectional view of the sample receiver of Figs. 1 and 2;

Fig. 4 is a sectional view of the mixing and accumulating tank of Figs. 1 to 3; and

Fig. 5 is a view of an embodiment in which the clean oil for the sample receiver is obtained from an exterior source.

Referring now to the drawings, in which identical numerals will be employed to identify identical parts, numeral 11 designates a circulating pump and numeral 12 designates a flow regulating pump. The apparatus includes a sample receiver 13, a sample container 14, and a mixing tank 15. The circulating pump 11 is provided with an intake port 16 which is adapted to be connected to a flowing stream in pipe line 17 by a first conduit 1. The discharge port 18 of circulating pump 11 is connected by a second conduit 2 to sample receiver 13. Second conduit 2 has arranged therein adjacent the lower end of sample receiver 13 a three-way valve 19, the function of which will be described in more detail hereinafter. The flow regulating pump 12 is connected to the upper end of sample receiver 13 by a third conduit 3 which connects to a vent pipe 20 containing a valve 21. Conduit 3 connects to intake port 22 of flow regulating pump 12.

The sample container 14 is connected to sample receiver 13 by a fourth conduit 4 in which is arranged a valve 23 for controlling the flow there-through. The conduit 4 connects to a conduit 24 which in turn connects to the sample container 14 and is adapted to discharge the contents thereof into a sump, not shown. The conduit 24 is provided with a valve 25. It will be noted that the sample container 14 is provided with an overflow pan or cup 26 which is an enlarged portion adjacent the top end thereof. The sample container 14 is also provided with a pet cock 26a which allows withdrawal of a spot sample at an intermediate point from sample container 14 for centrifugal tests and the like. The overflow pan or cup 26 has a conduit 27 for discharging the

overflow from container 14 into conduit 24 and thence to the sump, not shown.

The second conduit 2 has a fifth conduit 5 connected thereto which in turn is connected to a test gauge 23 for registering the pressure in conduit 5. Conduit 5 has arranged therein a check valve 29 which is set at a predetermined pressure to allow flow of fluid therethrough. The conduit 5 discharges into pipe line 17. The check valve 29 will allow flow through conduit 5 into pipe line 17 but will resist flow from pipe line 17 into conduit 5 and thence into conduit 2.

The flow regulating pump 12 has an outlet port 30 to which is connected a sixth conduit 6 which then connects in turn to conduit 5 allowing the discharge from the flow regulating pump 30 to discharge into conduit 5 and thence into pipe line 17 with a portion of the discharge from pump 11.

The apparatus of the present invention may include a filtering means 31 which may be of conventional design and may contain a filtering media such as horse hair felt, cellulosic material, asbestos, cloth, other vegetable fibers and the like which will serve to remove solid foreign material, such as rust, dirt and the like, from the oil withdrawn from pipe line 17. The filter 31 is provided with a cover 32 for easy access thereto and for replacement of the filter. The filter 31 is connected to conduit 3 by a seventh conduit 7 in which is arranged a check valve 33 which will allow flow through conduit 7 into conduit 3 but will resist flow from conduit 3 into the filter 31. Connected to the filter 31 and to conduit 5 is an eighth conduit 8 in which is arranged a check valve 34 which allows flow from conduit 5 to conduit 9 which connects to filter 31 but will resist flow from conduit 9 to conduit 5. Check valve 34 is arranged to allow flow of liquid from conduit 5 to flow into conduit 9 at a predetermined pressure. Conduit 9 is provided with a valve means 35 which may be opened to establish communication between conduit 6 and filter 31.

Branch line or conduit 36 connects conduit 2 with conduit 4. This line 36 is provided with a valve means 37 which may be opened to establish communication between conduit 2 and conduit 4 as will be described further.

It will be noted that conduit 1 is provided with a test gauge 38 to indicate pressure of the stream flowing from pipe line 17 through conduit 1 to pump 11.

The mixing tank 15 connects into conduit 4 by a conduit or line 15a which connects to line 4 between valve 19 and valve 23.

Pumps 11 and 12 are operated by a single prime mover 39 which may suitably be an electric or gasoline motor; preferably an electric motor, is employed. The prime mover 39 is provided with a drive wheel 39a on which is arranged belts or chains 40 which serve to drive drive wheels 41 and 42, respectively, of pumps 11 and 12.

Referring now to Fig. 2, it will be seen that the apparatus of the present invention may be arranged in a housing 50 provided with a door 51 which is swung on housing 50 by hinges 52. This door may be opened by handle 53. Arranged in a lower portion of the housing 50 defined by a cross piece 54 and bottom 55 are pumps 11 and 12 and motor 37, whereas arranged in the upper portion of the housing 50 defined by the cross piece 54 and the top thereof 56 are the sample receiver 13 and sample container 14 as well as mixing tank 15. The conduits connecting these various elements are not shown in this view.

The housing 50 may be suitably arranged on legs 64.

Referring now to Fig. 3, it will be seen that a piston 70 divides the sample receiver 13 into upper chamber 71 and into a lower chamber 72 which are sealed one from the other by providing a sealing means such as O-ring 73 on piston 70. The upper chamber 71 is suitably filled with a clean oil which may be the filtered oil while the lower chamber 72 contains the material sampled as will be described further.

A detail sectional view of the tank 15 is shown in Fig. 4. As shown, the tank 15 is provided with a handle 57 which connects by rod 58 to mixing plates 59.

Referring now to Fig. 5, a modified embodiment of our invention is shown in which the filter 31 and its attendant conduits are eliminated. This may be achieved by providing a tank 80 in which a body of clean oil is arranged which may be an oil which it is desired to pump down the pipe line along with the pipe line oil and may suitably be a gas oil, lubricating oil, or gasoline, and the like. Tank 80 communicates with conduit 3 by a conduit 81 in which is arranged a pump 82. Conduit 81 is also provided with a valve 83 to isolate the conduit 81 from the third conduit 3. It will be noted in this embodiment of our invention that the conduits 7, 8, 9, and filter 31 are eliminated. Also the check valve 34 in conduit 8 is not needed. It will be noted further that the conduit 6 connects directly into conduit 5 which in turn connects to the pipe line 17.

The apparatus of the present invention operates as follows: Assuming that it is desired to take a sample from the pipe line 17, the piston member 70 in the sample receiver 13 is in the bottom of the sample receiver 13, the piston member being shaped at its lower end to conform with the interior lower end of the sample receiver 13. In the upper chamber 71 is a body of clean oil which may be a portion of the oil from pipe line 17 which has been passed through the filter 31. The operation is started by energizing motor 37 which causes pumps 11 and 12 to operate. Pump 11 takes suction through conduit 1 on pipe line 17 and pumps oil through conduit 2 into the sample receiver 13 below the piston 70. The flow regulating pump 12 takes suction by line 3 on the clean oil in the upper section of the sample receiver at a predetermined rate; by virtue of controlling the output from the sample receiver by means of the flow regulating pump 12 it is possible to control flow thereinto through conduit 2. The check valve 29 in conduit 5 has been set to operate at a predetermined pressure and to discharge a major portion of the oil flowing through conduit 2 back into pipe line 17 through conduit 5. In short, a major portion of the oil is discharged back through the pipe line 17 while a minor portion passes through conduit 2 and valve 19 of the sample receiver 13 regulated by the amount of clean oil withdrawn by conduit 3 and pump 12. The discharge from flow regulating pump 12 flows through conduit 6 into conduit 5 and thence back to pipe line 17.

Once the sample receiver 13 has been filled the valve 19 is manipulated to allow flow in the direction indicated by the curved arrow which causes flow into line 15a and mixing tank 15, valve 23 in conduit 4 being in the closed position. With three-way valve 19 in such position that flow is allowed only through line 4 and line 15a to mixing tank 15, the pressure exerted by circulating pump 11 through line 2, line 5, line 8, line 9, filter

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31, line 7 and line 3 will force filtered oil into chamber 71 of sample receiver 13, thus forcing piston 70 down and displacing sample from chamber 72 through lines 4 and 15a to mixing tank 15. During this operation sample pump 12 will discharge its stream into circulating pump 11 discharge without interruption of its operation. Thereafter, once the sample has been displaced from sample receiver 13 into mixing tank 15, valve 19 is further manipulated to allow normal flow as indicated by the straight arrow into sample receiver 13.

Check valve 29 is a throttling type check valve providing a differential pressure of approximately 15 lbs. acting on the underside of piston 70. This pressure differential will overcome the weight and friction of piston 70 and will force it upward as sampling pump 12 removes the regulated amount of filtered oil from chamber 71, thus allowing sample to accumulate in chamber 72.

After the sampling period has been completed and the complete sample has been displaced into mixing tank 15, the contents thereof may be thoroughly mixed by manipulation of handle 15 in an up-and-down direction to cause thorough mixing of the contents thereof. Then the contents of mixing tank 15 may be gravitated into sample container 14 by opening valve 23 in conduit 4, the valve 25 in conduit 24 being in closed position and three-way valve 19 allows the clear stream from conduit 2 to flow to receiver 13. A suitable hydrometer may be inserted or maintained in the sample container 14 to determine the gravity of oil therein, the excess of the sample being allowed to overflow into overflow pan 26 and thence by conduit 27 into conduit 24 and to the sump, not shown. Suitably, if desired, the sample in sample container 14 may be discharged into barrels or another sample container by opening valve 25, valve 23 being meanwhile closed.

If it is desired to obtain a spot sample for determining any test this may be done simply by opening valve 37 in conduit 36 which will allow a portion of the discharge from conduit 2 to flow directly into conduit 4 and thence by conduit 24 into sample container 14. Of course, when a spot sample is taken valve 23 will be in a closed position. Thus, a spot sample may be obtained while filling sample receiver 13 as has been described.

Referring to the operation of the embodiment of Fig. 5, this embodiment operates in a similar way to that of Fig. 4 with the exception that the pump 82 is designed to pump at a faster rate than the pump 12 which will allow clean oil to be withdrawn from tank 80 through conduit 81 and thence by opening valve 83 to conduit 3 to sample receiver 13 as has been described.

In operating the apparatus of the present invention, when pipe line 17 contains a flowing stream under a pressure of 1000 lbs. the check valve 29 will be set to deliver oil through conduit 5 into pipe line 24 at a pressure of 1015 lbs. while the check valve 34 will deliver oil from the conduit 5 to the conduit 9 at a pressure of 1000 lbs. Similarly, the flow through conduit 7 into conduit 3 through check valve 33 will be realized by setting the check valve to deliver oil at a pressure of 1000 lbs. Under these conditions with the pipe line under pressure of 1000 lbs. the discharge from pump 11 is at 1015 lbs. and discharge from pump 12 is at 1015 lbs. Of course, it is realized that under different conditions of a flowing stream that it will be desirable to

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change the setting of the various check valves to allow the apparatus to function properly.

The nature and objects of the present invention having been completely described and illustrated, what we wish to claim as new and useful and to secure by Letters Patent is:

1. Apparatus adapted for obtaining a sample from a flowing stream to be sampled which comprises, in combination, a circulating pump and a flow regulating pump each having an intake port and a discharge port, a first conduit connecting to the intake port of the circulating pump and adapted to be connected to the flowing stream, a sample receiver, a piston member in said sample receiver, a second conduit connecting the discharge port of said circulating pump to a lower end of said sample receiver, a third conduit connecting the intake port of said flow regulating pump to an upper end of said sample receiver, a sample container, a fourth conduit connected to the lower end of said sample receiver and to said sample container, a fifth conduit connected to the second conduit and adapted to discharge into said flowing stream, a sixth conduit connected to the discharge port of said flow regulating pump and to said fifth conduit, and conduit means for introducing a clean liquid into said sample receiver above said piston member connected to said third conduit and to a source of said clean liquid.

2. Apparatus adapted for obtaining a sample from a flowing stream to be sampled which comprises, in combination, a circulating pump and a flow regulating pump each having an intake port and a discharge port, a first conduit connecting to the intake port of the circulating pump and adapted to be connected to the flowing stream, a sample receiver, a piston member in said sample receiver, a second conduit connecting the discharge port of said circulating pump to a lower end of said sample receiver, a third conduit connecting the intake port of said flow regulating pump to an upper end of said sample receiver, a sample container, a fourth conduit connected to the lower end of said sample receiver and to said sample container, a fifth conduit connected to the second conduit and adapted to discharge into said flowing stream, a sixth conduit connected to the discharge port of said flow regulating pump and to said fifth conduit, mixing and accumulating means arranged between said sample receiver and container fluidly connected to said fourth conduit, and conduit means for introducing a clean liquid into said sample receiver above said piston member connected to said third conduit and to a source of said clean liquid.

3. Apparatus adapted for obtaining a sample from a flowing stream to be sampled which comprises, in combination, a circulating pump and a flow regulating pump each having an intake port and a discharge port, a first conduit connecting to the intake port of the circulating pump and adapted to be connected to the flowing stream, a sample receiver, a piston member in said sample receiver, a second conduit connecting the discharge port of said circulating pump to a lower end of said sample receiver, a third conduit connecting the intake port of said flow regulating pump to an upper end of said sample receiver, a sample container, a fourth conduit connected to the lower end of said sample receiver and to said sample container, a fifth conduit connected to the second conduit and adapted to discharge into said flowing stream, a sixth conduit connected to the discharge port of said flow regulating pump

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and to said fifth conduit, filtering means, a seventh conduit connecting said filtering means and said third conduit, and eighth and ninth conduits connecting said filtering means to said fifth and sixth conduits, respectively, for introducing a filtered portion of said flowing stream into said sample receiver above said piston member.

4. Apparatus adapted for obtaining a sample from a flowing stream to be sampled which comprises, in combination, a circulating pump and a flow regulating pump each having an intake port and a discharge port, a first conduit connecting to the intake port of the circulating pump and adapted to be connected to the flowing stream, a sample receiver, a piston member in said sample receiver, a second conduit connecting the discharge port of said circulating pump to a lower end of said sample receiver, a third conduit connecting the intake port of said flow regulating pump to an upper end of said sample receiver, a sample container, a fourth conduit connected to the lower end of said sample receiver and to said sample container, a fifth conduit connected to the second conduit and adapted to discharge into said flowing stream, a sixth conduit connected to

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the discharge port of said flow regulating pump and to said fifth conduit, filtering means, a seventh conduit connecting said filtering means and said third conduit, and eighth and ninth conduits connecting said filtering means to said fifth and sixth conduits, respectively, for introducing a filtered portion of said flowing stream into said sample receiver above said piston member, flow resisting means in each of said fifth, seventh, and eighth conduits adapted to allow flow at predetermined pressure in one direction and to resist it in another direction, and valve means in said second, fourth, and ninth conduits to control the flow therethrough.

DAVID H. MCKINNEY,
WILLIAM A. HARRIS.

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