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CONDENSATE RETURN SYSTEM

Filed July 9, 1934

2 Sheets-Sheet 1

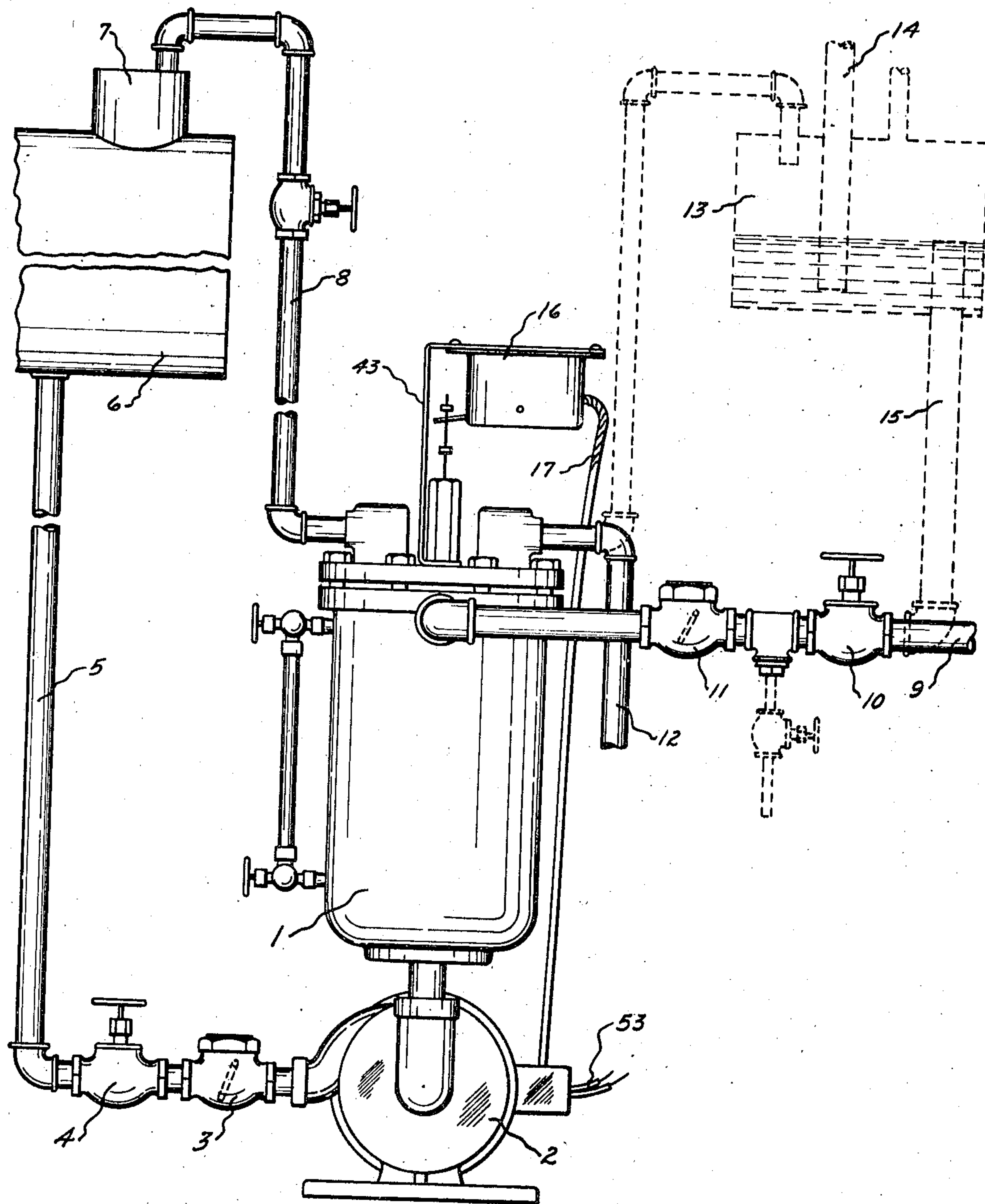


Fig. 1

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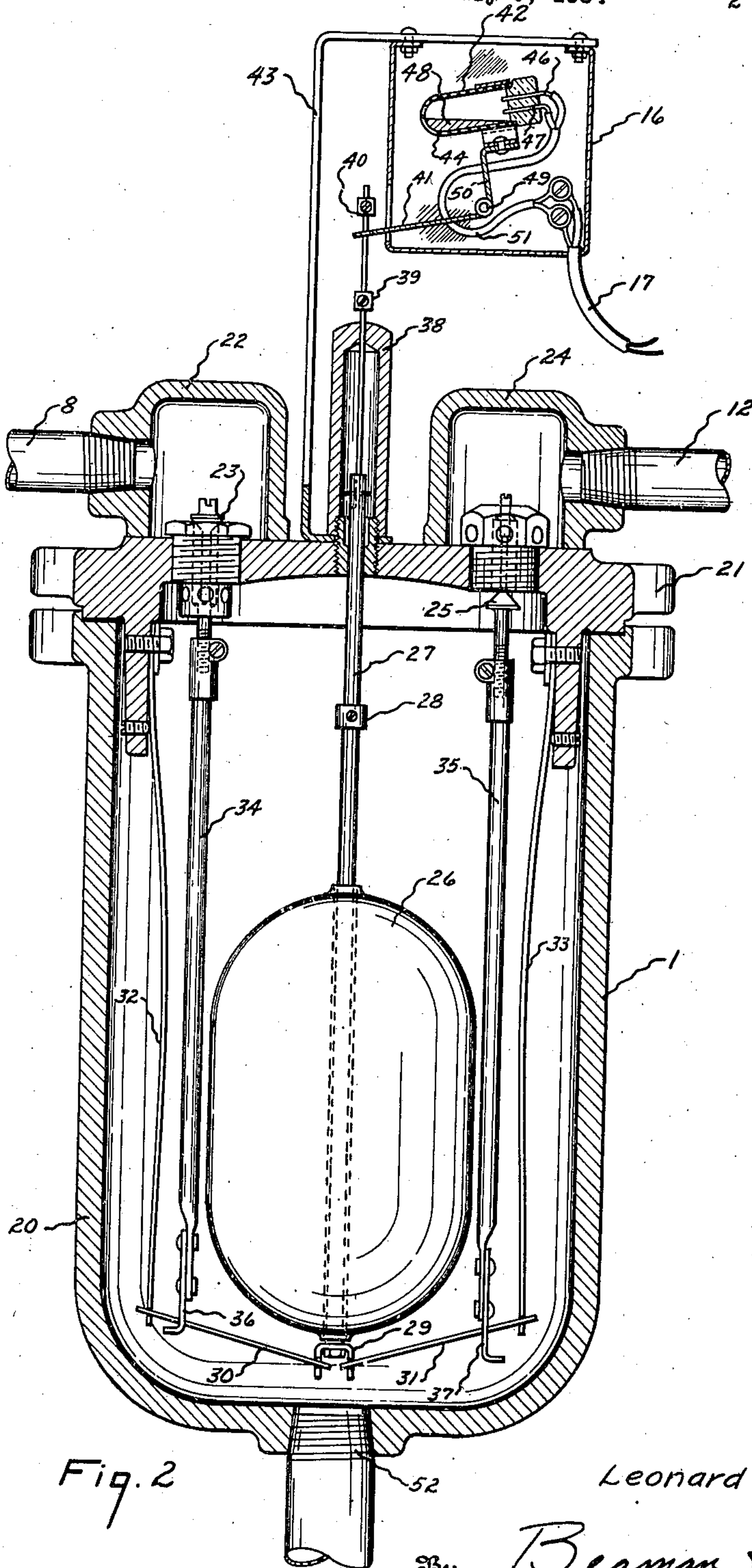


Fig. 2

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## UNITED STATES PATENT OFFICE

2,011,626

## CONDENSATE RETURN SYSTEM

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19 Claims. (Cl. 103—26)

The invention relates to a return system and method and particularly to an improved system and method for returning condensate to boilers by means of a return trap, the use of which is not limited by lack of head room above boilers or lack of means for elevating the condensate to a return trap located over the boiler, and a system that may be used on high pressure boilers as well as low.

Heretofore return traps have been offered as a more economical and efficient method for returning condensate to boilers, particularly high pressure, but their use has been limited to those places where the trap could be located above the boiler so that the condensate might drain by gravity into the boiler, the speed of draining depending on the elevation of the trap above the water line in the boiler and the resistance offered by necessary elbows, fittings and check valves. With the old systems it has been necessary to carry enough pressure on a line to elevate the condensate to the trap above the boiler either directly, or by means of a lift trap which was supplied with the necessary pressure direct from the boiler. Otherwise it has been necessary to use power operated pumps which are expensive and in many cases inefficient.

An object of this invention is to overcome the above difficulties by equalizing the pressure in the trap with that in the boiler and pumping the condensate from the trap into the boiler against a head independent of the pressure in the boiler.

Another object of this invention is to equalize the pressure in the trap with that in the boiler when the trap is below the water level in the boiler and to pump the condensate from the trap into the boiler against a head equivalent only to the height through which the condensate must be lifted, thus reducing the power required for pumping to a minimum.

Still another object of this invention is to provide a system for pumping fluid from a low pressure container to a high pressure container wherein the pressure in the low pressure container is equalized with that in the high pressure container and the pump works only against a head equivalent to the height to which the fluid must be lifted.

Another object of this invention is to provide a return system for transferring condensate from a return trap to a boiler wherein, upon the condensate in the trap reaching a predetermined level, the pressure in the trap is equalized with that in the boiler and the pump becomes operative to transfer the condensate from the trap to

the boiler against a head equivalent only to the height to which the condensate must be lifted.

These and other objects will be apparent from the following specification when taken with the accompanying drawings in which,

Fig. 1 is a general plan of the apparatus and connections included in the system, and

Fig. 2 is a vertical section through the trap disclosing the operative mechanism therein and the details of the mercury switch.

Referring particularly to Fig. 1, the reference character 1 designates a return trap. A centrifugal pump 2 receives condensate from the bottom of the trap 1 and is connected to pump the condensate through a check valve 3, the gate valve 4 and the pipe 5 to the bottom of the boiler 6. The boiler 6 is provided with a dome 7 and has communicating therewith the pipe 8 for conducting pressure steam to the trap 1. The trap 1 is not a part of this invention and is more fully described both as to operation and as to structure in my copending application Ser. No. 732,822, filed June 28, 1934.

Condensate is admitted to the trap 1 through the pipe 9 having therein the gate valve 10 and the check valve 11. In order to vent the air in the trap 1 while condensate is flowing into it the vent pipe 12 is provided to provide a communication between the trap 1 and the atmosphere.

The source of supply of the condensate passing through the pipe 9 depends upon the complete system in which this invention is used. For instance, it might be received directly from a plurality of individual steam traps. Another source might be as shown in dotted lines in Fig. 1 wherein the condensate is collected in the tank 13 through the pipe 14 and is fed by gravity therefrom through the pipe 15 to the pipe 9.

The pump 2 is preferably electrically driven and is started and stopped by a suitable switch such as a mercury switch generally indicated by the housing 16 in Fig. 1. A conductor 17 completes the circuit between the mercury switch and the pump 2.

Referring particularly to Fig. 2 disclosing a vertical section of the trap 1, the trap 1 is provided with a casing 20 having secured thereto a cover plate 21. Disposed on the top of the cover plate 21 is a pressure steam inlet housing 22 communicating through the pressure steam inlet valve 23 with the interior of the casing 20. Likewise secured to the top of the cover plate 21 is a vent housing 24 communicating through the vent valve 25 with the interior of the casing 20.

Within the casing 20 is disposed a float 26 for



operating the switch 16 and the valves 23 and 25, slidably secured by a lost motion connection to the spindle 27. The adjustable collar 28 and the U-shaped strip 29 both secured to the spindle 27 define the limits of the lost motion connection of the float 26 on the spindle 27. The valves 23 and 25 are operated directly by a toggle having arms 30 and 31 supported at their interior ends by the U-shaped strip 29 and at their exterior ends by the inwardly urged spring strips 32 and 33, respectively. The connections at each end of the toggle levers 30 and 31 are pivotal. Depending from the valves 23 and 25 are elongated stems 34 and 35 respectively having L-shaped connectors 36 and 37 each secured by a lost motion connection to the toggle arms 30 and 31, respectively.

The upper end of the spindle 27 extends through a housing 38 secured to the cover plate 21. On the portion of the spindle 27 above the housing 38 are adjustable collars 39 and 40. Loosely and slidably connected to the spindle 27 between the collars 39 and 40 is the arm 41 of the mercury switch 42 mounted in the housing 16. The housing 16 is supported from the cover plate 21 by the bracket 43. The mercury switch 42 comprises a bulb 44 having a plug of glass or of some other suitable insulating material sealing one end. Molded in the plug 45 are two electrodes 46 and 47 extending into the interior of the bulb 44. Mercury 48 is disposed within the bulb 44 for bridging the gap between the electrodes 46 and 47. The switch 42 is pivotally mounted on the pin 49 being supported thereon by the arm 50 connected to the arm 41.

The operation of the mercury switch is such that when the float 26 is at its lowermost position the switch is tilted to the left and the mercury 48 is away from the electrodes 46 and 47. Further tilting to the left is prevented by the arm 41 resting angularly against the spindle 27. When the condensate rises to such a level in the casing 20 that the valve 23 opens and the valve 25 closes the collar 39 engages with the arm 41 to rock the mercury switch to the right whereby the mercury 48 bridges the gap between the electrodes 46 and 47 and closes the pump circuit in which they are included. Further tilting to the right of the switch 42 is prevented by the arm 41 angularly resting against the spindle 27. A flexible connection 51 connects the electrodes 46 and 47 with the conductor 17 leading to the centrifugal pump 2.

The operation is as follows: Assuming that the trap 1 is empty and that the condensate is flowing through the pipe 9 into the trap, the position of the pressure steam valve 23, the vent valve 25, the float 26 and the mercury switch 42 will be as shown in Fig. 2. High pressure steam is excluded by the valve 23 and the interior of the casing 20 of the trap 1 is open to the atmosphere through the vent valve 25 and the vent pipe 12. Upon the level of the condensate within the casing 20 rising to such a height that the float 26 strikes the collar 28, the spindle 27 is lifted carrying with it the inner end of the toggle levers 30 and 31 and the arm 41 of the mercury switch 42. When the toggle levers 30 and 31 are raised to a position just past that of horizontal alignment the inwardly urged springs 32 and 33 snap the toggle levers rapidly upwardly opening the steam valve 23 and closing the vent valve 25. At the same time the collar 39 on the spindle 27 lifts the arm 41 upwardly a sufficient distance to overbalance the switch 42 to tilt it to the right whereat the mer-

cury 48 bridges the gap between the electrodes 46 and 47 to close the pump circuit to start the pump.

The opening of the valve 23 admits pressure steam into the casing 20 and the closing of the valve 25 prevents its escape. Pressure steam is also prevented from escaping through the condensate inlet pipe 9 by the check valve 11. The pressure in the trap 1 is thus equalized with that in the boiler 6. Condensate in the casing 20 of the trap 1 is constantly in communication through the opening 52 in the bottom of the casing 20 with the pump 2. The condensate is prevented from passing out of the pump 2 by the check valve 3 maintained closed by the boiler pressure passing through the pipe 5 and the gate valve 4. At the moment the pressure in the casing 20 of the trap 1 is equalized with that in the boiler 6, the mercury switch 42 is closed starting the operation of the pump. The condensate is thus drawn from the casing 20 and discharged through the check valve 3, the gate valve 4 and the pipe 5 into the boiler 6. Power for driving the pump 2 is received through the conductors 53, from any suitable source.

As soon as the condensate is discharged, the float 26 falls and brakes the U-shaped strip 29 whereupon the position of the toggle 30 and 31 is reversed to close the steam valve 23 and open the vent valve 25. At the same time the collar 40 on the downwardly moving spindle engages the arm 41 of the mercury switch 42. The mercury switch 42 is then tilted to the left whereby the mercury 48 in the bulb 42 flows, due to the action of gravity, from across the electrodes 46 and 47 to open the pump circuit. The pressure in the casing 20 of the trap 1 is vented to the atmosphere by the opening of the valve 25 and condensate may again enter through the pipe 9.

It will become apparent that I have provided a return trap and pump combination in which the boiler pressure is equalized upon the condensate being pumped or at least utilized to some extent to facilitate the return of the condensate to the boiler resulting in the size of the pump and operating power required being reduced to a minimum. Also, I have provided a return trap and pump combination in which the discharge of the trap and operation of the pump is synchronized and the same source of pressure is utilized to facilitate the discharge of the trap and pumping of the condensate against boiler pressure. The use of any type of pump in which the equalized pressure upon the condensate is made available to the pumping operation, is contemplated.

While the foregoing specification has described a specific trap as being a part of the system comprising this invention it is contemplated that any suitable trap may be used including those known as "tilt traps" and "floated weight traps". If desired the condensate inlet pipe 9 may be connected to the inlet 52 at the bottom of the trap instead of to the side near the top as shown. Further this invention is not limited to a centrifugal pump and either manually or power operated pumps may be used. Further this invention is not intended to be limited to the return of condensate to a boiler although it is particularly adaptable for this purpose. It is also contemplated that instead of using mercury operated switches to initiate the operation of the pump that a diaphragm actuated upon admission of pressure to the trap being used or that actuating mechanism controlled by the weight of water rather than the buoyancy of water, may be substituted. While



it is also preferred that the pressure in the trap be equalized with that in the boiler, it is intended that constructions wherein the pressure differential between the boiler and the trap is reduced be included within the scope of the invention. I therefore do not wish to be limited except by the scope of the following claims.

I claim:

1. A return system for association with a steam boiler comprising means for receiving condensate, means for equalizing the pressure in said receiving means with the pressure in the boiler when the condensate in said receiving means has risen therein to a predetermined level, and means while operative substantially continuously subject to the pressure in said receiving means for positively transferring the condensate from said receiving means to said boiler while said pressures are equalized, whereby the head against which said transferring means operates is independent of the pressure in the boiler.
2. A return system for association with a steam boiler comprising means for receiving condensate, conduit means connecting the boiler and said receiving means, pumping means in said conduit for positively transferring the condensate from said receiving means to said boiler, means for equalizing the pressure in said receiving means with the pressure in the boiler, and means initiating the operation of said pump concurrently with the equalizing of the pressure in the boiler and said receiving means, whereby the head against which said pumping means operates is independent of the pressure in the boiler.
3. A return system for association with a steam boiler comprising means for receiving condensate disposed below the level of the boiler, means for equalizing the pressure in said receiving means with the pressure in said boiler when the condensate in said receiving means has risen therein to a predetermined level, and means while operative substantially continuously subject to the pressure in said receiving means disposed between said receiving means and the boiler for transferring the condensate from said receiving means to said boiler while said pressures are equalized, whereby the head against which said transferring means operates is independent of the pressure in the boiler.
4. A return system for association with a steam boiler comprising means for receiving condensate disposed below the level of the boiler, means dependent on the level of the condensate in said receiving means for equalizing the pressure in said receiving means with that in the boiler, and means while operative substantially continuously subject to the pressure in said receiving means disposed between said receiving means and the boiler operative to transfer the condensate from said receiving means to said boiler while said pressures are equalized, the operation of said means being controlled by the level of the condensate in said receiving means, whereby the head against which said transferring means operates is independent of the pressure in the boiler.
5. A return system for association with a steam boiler comprising means for receiving condensate, disposed below the level of the boiler, mechanism associated with said receiving means operative, upon the level of the condensate in said receiving means reaching a predetermined level, to equalize the pressure in said receiving means with the pressure in the boiler, and a pump while operative substantially continuously subject to the pressure in said receiving means disposed between said re-

ceiving means and the boiler for transferring the condensate in said receiving means to said boiler while said pressures are equalized, whereby the head against which said pump operates is independent of the pressure in the boiler.

6. A return system for association with a steam boiler comprising means for receiving condensate, means dependent on the level of the condensate in said receiving means for equalizing the pressure in said receiving means with that in the boiler, and means while operative substantially continuously subject to the pressure in said receiving means disposed between said receiving means and the boiler operative positively to transfer the condensate from said receiving means to said boiler while said pressures are equalized, the operation of said means being controlled by the level of the condensate in said receiving means, whereby the head against which the transferring means operates is independent of the pressure in the boiler.

7. A return system for association with a steam boiler comprising means for receiving a condensate, mechanism associated with said receiving means operative, when the level of the condensate in said receiving means reaches a predetermined level, to equalize the pressure in said receiving means with the pressure in said boiler, and pumping means while operative substantially continuously subject to the pressure in said receiving means disposed between said receiving means and the boiler for transferring the condensate from said receiving means to said boiler while said pressures are equalized, whereby the head against which the pumping means operates is independent of the pressure in the boiler.

8. A return system for association with a steam boiler comprising a return trap for receiving a condensate disposed below the level of said boiler, mechanism associated with said return trap operative, upon the level of the condensate in said return trap reaching a predetermined level, to equalize the pressure in said return trap with that in the boiler, and a pump while operative substantially continuously subject to the pressure in said trap for transferring the condensate in said trap to said boiler while said pressures are equalized, whereby the head against which the pump operates is independent of the pressure in the boiler.

9. A return system for association with a steam boiler comprising a return trap for receiving condensate, a conduit connecting the boiler with said trap, a pump in said conduit while operative substantially continuously subject to the pressure in said trap for pumping condensate from said trap to said boiler and means both for equalizing the pressure in said boiler and in said trap and for starting said pump upon the rising of the condensate in said trap to a predetermined level, whereby the head against which the pump operates is independent of the pressure in the boiler.

10. A system for discharging a fluid from a low pressure container into a high pressure container comprising means to equalize the pressure in said low pressure container with that in the high pressure container, and means while operative substantially continuously subject to the pressure in said low pressure container for positively transferring the fluid from said low pressure container to said high pressure container while said pressures are equalized whereby the head against which said transferring means operates is independent of the pressure in the high pressure container.



11. A system for discharging a fluid from a low pressure container to a high pressure container comprising means for reducing the differential pressure between the low pressure container and the high pressure container and means while operative substantially continuously subject to the pressure in said low pressure container for positively transferring the fluid from said low pressure container to said high pressure container whereby the head against which said transferring means operates is less than the pressure in the high pressure container.

12. A system for discharging a fluid from a low pressure container into a high pressure container comprising mechanism associated with said low pressure container to equalize the pressure therein with the pressure in the high pressure container, and means while operative substantially continuously subject to the pressure in said low pressure container for transferring the fluid from said low pressure container to the high pressure container while said pressures are equalized, said means being controlled by the condition existing within the low pressure container whereby the head against which said transferring means operates is independent of the pressure in the high pressure container.

13. A system for discharging a fluid from a low pressure container into a high pressure container comprising a pump while operative substantially continuously subject to the pressure in said low pressure container for transferring fluid from the low pressure container to the high pressure container, and means operative to equalize the pressure in the low pressure container with that of the high pressure container and to start said pump, upon the raising of the condensate in said container to a predetermined level, whereby the head against which said pump operates is independent of the pressure in the high pressure container.

14. A system for discharging a fluid from a low pressure container into a high pressure container comprising means for connecting the high pressure container with the low pressure container for equalizing the pressures therein and means while operative substantially continuously subject to the pressure in said low pressure container for positively transferring fluid from said low pressure container to said high pressure container while said pressures are equalized whereby the head against which said transferring means operates is independent of the pressure in the boiler.

15. A return system for association with a steam boiler comprising means for receiving a condensate, mechanism associated with said receiving means for controlling valves to connect said receiving means with the boiler to equalize the pressure in said receiving means with that in the boiler, and means while operative substantially continuously subject to the pressure in said receiving means dependent on conditions in said receiving means for transferring condensate from said receiving means to the boiler while said pressures are equalized whereby the head against which said transferring means operates is independent of the pressure in the boiler.

16. The method of transferring a fluid from a low pressure container to a high pressure container which comprises equalizing the pressure in the low pressure container with that in the high pressure container and positively transferring the fluid through a closed connection from the low pressure container to the high pressure container while said transferring means is substantially continuously subject to the pressure in the low pressure container, whereby said fluid is transferred to the high pressure container against a head independent of the pressure in the high pressure container.

17. The method of returning condensate to a boiler which comprises collecting the condensate in a trap, and equalizing the pressure in the trap with that in the boiler while pumping the condensate from the trap to the boiler against a head independent of the boiler pressure.

18. The method of transferring a fluid from a low pressure container to a high pressure container which comprises collecting the fluid at atmospheric pressure in a collector, equalizing the pressure in the collector with that in the boiler and simultaneously pumping it into the high pressure container against a head independent of the boiler pressure.

19. The method of transferring a fluid from a low pressure container to a high pressure container which comprises reducing the differential pressure between the low pressure container and the high pressure container, and positively transferring the fluid through a closed connection from the low pressure container to the high pressure container against a head less than the pressure in the high pressure container.

LEONARD D. GOFF.

**CERTIFICATE OF CORRECTION.**

**Patent No. 2,011,626.**

**August 20, 1935.**

**LEONARD D. GOFF.**

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 27, for "brakes" read strikes; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of September, A. D. 1935.

(Seal)

**Leslie Frazer**  
**Acting Commissioner of Patents.**