

Sept. 20, 1938.

D. T. WILLIAMS

2,130,516

PUMPING APPARATUS

Filed Nov. 20, 1936

3 Sheets-Sheet 1

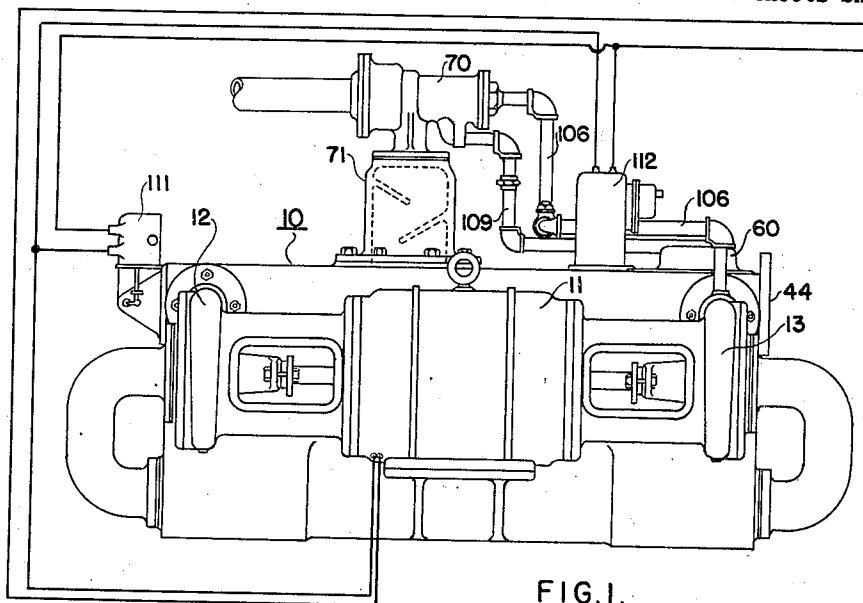


FIG. 1.

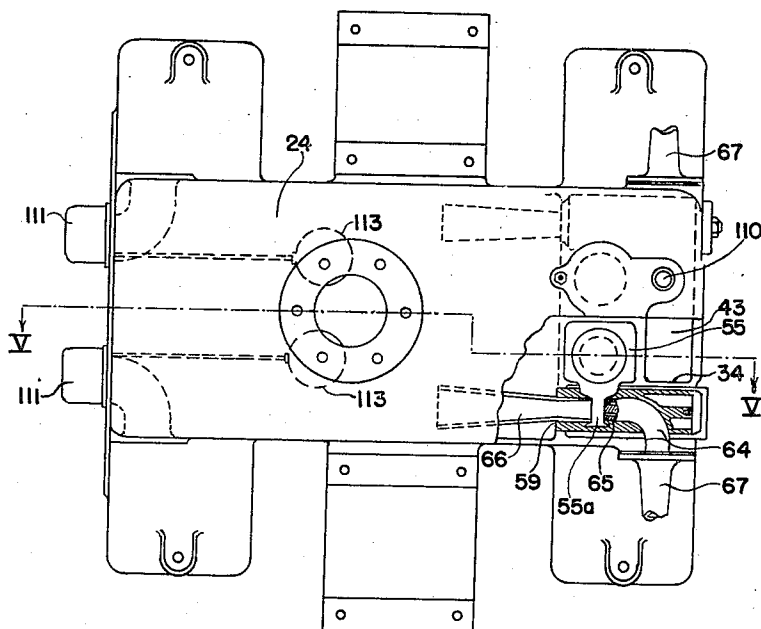


FIG. 2.

INVENTOR.
DAVID T. WILLIAMS

BY

Charles S. Williams
ATTORNEY.

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Charles S. Martin
ATTORNEY.

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FIG. 6

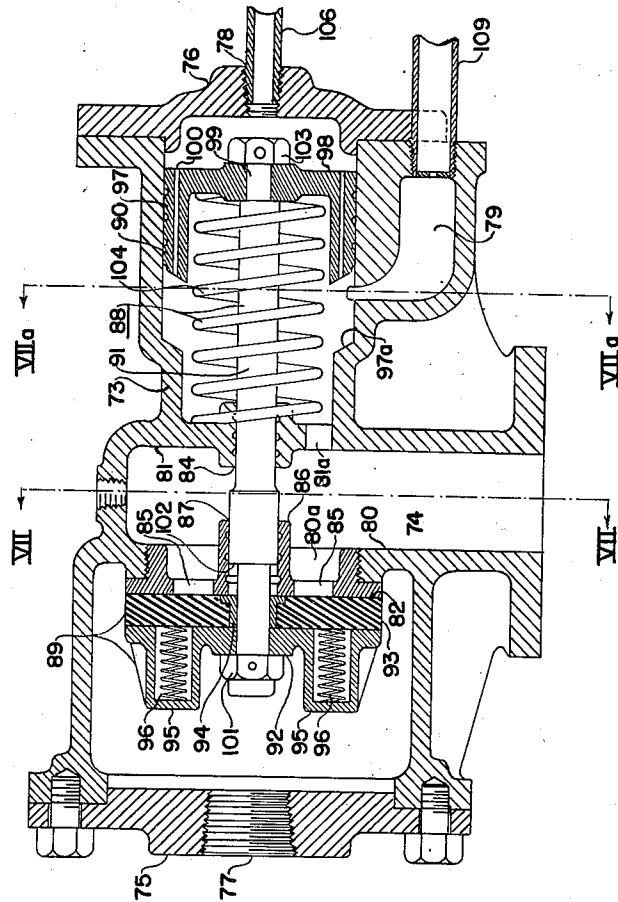
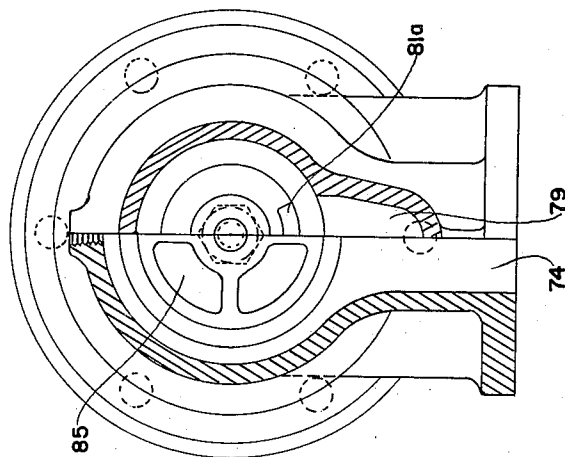


FIG. 7



BY

DAVID T. WILLIAMS

INVENTOR.

Charles J. Martin
ATTORNEY.

UNITED STATES PATENT OFFICE

2,130,516

PUMPING APPARATUS

David T. Williams, Larchmont, N. Y.

Application November 20, 1936, Serial No. 111,756

14 Claims. (Cl. 103—6)

This invention relates to fluid pumping apparatus and is particularly concerned with pumping apparatus such as is employed in connection with fluid circulating systems, as, for example, steam heating systems.

In modern systems of the type mentioned, the circulation therethrough of fluid, that is steam as well as water and air, is ordinarily effected by providing a vacuum at the return ends of the systems, suitable fluid pumping apparatus being required for this purpose. It is further required that means be provided for separating air and condensate or water, which is withdrawn from the return main of the system, exhausting the air to the atmosphere and delivering the water to an appropriate point in the system, such as the boiler thereof, where it may be again converted to steam and recirculated through the system. Moreover, it is essential from practical and commercial standpoints that apparatus of this type be characterized by high efficiency and dependability in operation, as well as simplicity and sturdiness of construction.

Apparatus of this type, designed in various different manners have heretofore been provided but have not proved entirely satisfactory in that they lacked, in whole or in part, one or more of the essential characteristics enumerated above. According to conventional practice, such apparatus embodies a receiving tank or chamber into which are delivered the return products including the air and water withdrawn from the system. In accordance with certain designs of the apparatus, which have otherwise proved relatively satisfactory, the operating vacuum is created within the receiving chamber, so that it must be exerted upon the system by way of water in the lower part of the chamber. In other words, the air from the return main of the system must be withdrawn through the condensate in the bottom of the receiving tank. For obvious reasons, such an indirect method of applying the vacuum is inefficient and, further, it has entailed an undesirable complexity of apparatus. Moreover, systems of the type which have heretofore been used were characterized in that the return condensate or water in their receiving chambers was withdrawn therefrom against the resistance of vacuums within the chambers and return system and separate chambers under atmospheric pressures were required in addition to the receiving chambers for the purpose of separating the air and water withdrawn from the return system.

It is a primary object of the present invention to provide an improved fluid pumping apparatus

which is particularly well adapted for use in connection with fluid circulating systems, such as vacuum steam heating systems.

A further object of the invention is to provide an improved apparatus of the type described embodying all of the essential characteristics enumerated above.

A particular object of the invention is to provide an improved apparatus of the type described, characterized by high efficiency and simplicity in the manner in which the vacuum is developed and applied.

A further particular object of the invention is to provide an improved apparatus of the character described, wherein the necessity of utilizing a separate or additional chamber for separation of the air from the water withdrawn from the return main is avoided.

Still another object of the invention is to provide an improved automatic control valve which is especially well adapted for use as a part of the improved fluid pumping apparatus of the type described.

In accordance with a preferred embodiment of the present invention, a fluid pumping apparatus is provided which includes an inlet adapted for connection with the return main of a fluid circulating system, and a receiving tank or chamber for receiving return products including gas or air and water or condensate from the system. Individual passageways are provided for the flow of liquid and gas, respectively, from the inlet to the chamber and pumping means are provided for producing a vacuum directly at the inlet and independently of the receiving chamber during periods when the pumping means are in operation. The separation of the air from the water withdrawn from the return main is effected in the receiving chamber itself, the air being preferably exhausted therefrom directly to the atmosphere without the use of any additional chamber for this purpose. More particularly, one passageway is arranged to so connect the inlet of the apparatus with the receiving chamber as to permit the flow of water therethrough and the other passageway is arranged to so connect the inlet with the chamber as to permit the flow of air therethrough while substantially avoiding the flow of water therethrough. The pumping means are provided in connection with the second-mentioned passageway for producing a vacuum, that is, a sub-atmospheric pressure, directly at the inlet at a region separate from the receiving chamber to effect the withdrawal of gases from the return main of the system through the inlet

and the delivery thereof through the second-mentioned passageway into the receiving chamber. Automatic control valve means are also preferably provided, which means are arranged to be operable in response to the operation of the pumping means and serve to connect the receiving chamber with the atmosphere during pumping operations and to connect the receiving chamber with the inlet to equalize the pressures in the chamber and inlet when the pumps are inoperative.

Suitable means are provided for pumping water from the receiving chamber to an appropriate point in the system in connection with which the apparatus is employed. The latter means and the vacuum producing pumping means are arranged to be automatically controlled in accordance with either or both the air pressure at the inlet and the water level in the receiving chamber.

A better understanding of the present invention may be had by reference to the following detailed description of a preferred embodiment thereof, which is illustrated in the accompanying drawings, and its scope is pointed out in the appended claims.

In the accompanying drawings, Fig. 1 is a side elevation of a fluid pumping apparatus embodying the present invention; Figs. 2-5, inclusive, are additional views of the apparatus shown in Fig. 1, with certain parts omitted in these views for the purpose of clarity, Fig. 2 being a plan view with a part broken away and certain parts shown in horizontal section, Fig. 3 being an end elevation as viewed from the left in Fig. 1, Fig. 4 being at the right half an elevation as viewed from the right in Fig. 1 and at the left half a section on the line IV-IV of Fig. 5, and Fig. 5 being a vertical longitudinal section on the line V-V of Fig. 2; Fig. 6 is an enlarged longitudinal vertical sectional view of the automatic control valve shown in Fig. 1; and Fig. 7 is a transverse vertical sectional view of the control valve, the left half being taken on the line VII-VII and the right half being taken on the line VIIa-VIIa of Fig. 6.

Referring now more particularly to the drawings, the preferred embodiment of the pumping apparatus illustrated is of the dual type, such as is at present most generally employed in the art. Thus, except for certain common portions, which will be presently pointed out, the opposite halves of the apparatus shown constitute two substantially identical and independent apparatuses which may be operated either in unison, individually, or alternately, as desired. For the purpose of brevity in this description, where two identical parts or arrangements are included in the apparatus, only the one on the side thereof shown in Fig. 1 will be described in detail. For the purpose of clarity, similar parts of the opposite halves of the apparatus are, in some instances, indicated in the drawings by the same reference numerals.

The apparatus comprises, in general, a closed generally rectangular vessel indicated at 10 in Fig. 1 having, suitably mounted at each of its opposite sides, a motor 11 and water and air pumps 12 and 13, respectively, the pumps being operably connected to their respective motors, as shown, to be driven thereby. Any suitable conventional types of electric motors and pumps may be employed, but preferably centrifugal water pumps or rotative air pumps are utilized.

The vessel 10 comprises top and bottom walls

14 and 15, side walls 16 and 17, and end walls 18 and 19. A vertical transverse partition 20, as clearly shown in Fig. 5, divides the vessel into two portions, the portion to the left of the partition constituting a receiving chamber 21. A partition 22 extends between the side walls 16 and 17 horizontally into the chamber from the lower portion of the partition 20 and vertically upward to the top wall 14, dividing the chamber into an inlet portion 23 and main portion 24. An opening 25 is formed in the upper portion of the partition 22.

Water outlet openings 26 (see Figs. 3 and 5) are provided in the end wall 18 at the lower portion thereof, and these openings are connected by way of suitable pipes 27 to the inlets of the water pumps 12. The outlets 28 of the pumps 12 are, in turn, connected with ducts 29, as shown in Fig. 5, which are preferably integrally formed in the chamber structure and having flanged outlet openings 30, as shown in Fig. 3, adapted for connection with suitable pipes (not shown) which, for instance, may lead to the boiler of the heating system in connection with which the apparatus of the invention is employed.

The portion of the vessel at the right of the partition 20, or at the inlet end of the apparatus, includes three lower chambers, including an intermediate chamber 31 and side chambers 32 (see Fig. 4), which are defined by the bottom wall 15, end wall 19, and the partition 20. The right end portions of the side walls 16 and 17 constitute the outer side walls of the chambers 32. Two additional vertical longitudinal walls 33, spaced inwardly from the side walls 16 and 17, provide dividing walls between the chambers 31 and 32, as shown. Openings 34 are provided in the upper portion of the partition 20 connecting the chambers 32 with the inlet portion 23 of the receiving chamber to permit the flow of water therebetween.

This end of the vessel is further divided by a stepped partition (see Fig. 5) including four sections 39, 40, 41, and 42. The sections 39, 40, and 41 extend between the walls 33. The section 39 is horizontal and extends toward the right end of the apparatus from an intermediate part of the partition 20. The section 40 extends vertically upward from the right edge of the section 39 and the section 41 extends horizontally from the upper edge of the section 40. The remaining section 42 extends vertically between the right edge of the section 41 and the upper wall 14 of the vessel. The region above the chamber 31, between the walls 33 and between the section 42 and the end wall 19, thus defines an entrance chamber or inlet 43 which is provided with a flanged opening 44, formed in the upper portion of the wall 19 and adapted for connection with the return main of the fluid circulation system in connection with which the apparatus is employed.

An opening 45 is provided in the partition section 40, and a corresponding opening 46 is formed opposite thereto in the end wall 19. A hollow cylindrical screen member 47, open at its left end and closed at its right end by a cover plate 48, is inserted through the opening 46 and extends across the upper portion of the chamber 31, with its open left end registering with the opening 45 and its cover plate closing the opening 46. An inverted V-shaped baffle 49 is provided between the partition section 40 and the end wall 19 at the upper and right end of the chamber 31,

so as to protect the upper portion of the screen member 47 from any dirt or foreign matter being deposited thereon from the chamber 43.

An opening 50 is formed in the lower portion of the wall 19 to permit the removal of solid foreign matter which may be deposited and permitted to settle in the chamber 31, and a removable cover 51 is provided for this opening. The covers 48 and 51 are locked in place by an arm member 52, which may be bolted to the end wall 19, as shown.

Between the partition 20 and the partition section 42 a further horizontal section 53 and a further vertical partition 54 (see Fig. 4) divide this part of the vessel so as to form two separate vacuum chambers 55. The region below the chambers 55 constitute a passageway 56 open to the chamber 31 by way of the opening 45. Openings 57 are formed in the horizontal partition 53, one for each of the chambers 55, to provide communication between these chambers and the passageway 56. Valves 58 (see Fig. 4) are provided, however, for each of the openings 57 and are constrained to closed positions by gravity or a light spring tension, so as to permit the flow of water only in one direction—from the passageway 56 to the chambers 55. Openings 59 (see Fig. 2) are formed in the partition 20 at the side of the chambers 55 for a purpose presently to be explained.

The top wall 14 of the vessel is provided with openings above the chambers 55 and 43 and removable cover members 60 are provided for these openings, and are so shaped as to constitute connecting passageways 61 between the upper portions of the chambers 55 and 43. The upper end of the chamber 43, however, is closed by partitions 62 and valve elements 63, as shown in Fig. 4, which are similar in construction to the partition 53 and the valve elements 58.

Adjacent to each of the chambers 55 a duct 64 (see Fig. 2) is integrally formed. An exhaust nozzle 65 is fitted in one end of each of the ducts 64 opposite the opening 59 in its respective chambers 55. A Venturi tube 66 is secured in each of the openings 59 spaced from and in alignment with the nozzle 65, and opening into the inlet portion 23 of the receiving chamber 21. The regions between the nozzle 65 and the Venturi tubes, which are indicated at 55a, may be termed suction spaces, since gases at these locations are sucked into the tubes when water is forced across the spaces from the nozzles and through the tubes. The opposite ends of the ducts 64 are connected to the outlets 67 of the pumps 13, as shown. Openings 68, as shown in Fig. 4, are formed in the end wall 19, connecting with each of the chambers 32, and these openings are connected by pipes 69 with the inlets of the pumps 13, as shown.

For the purpose of obtaining the required pressures in the several parts of the apparatus at the proper times, an automatic control valve, indicated generally at 70, is secured to the upper end of a baffled passageway 71 which, in turn, is mounted over an opening 72, formed in the upper wall 14 above the chamber 21. The valve 70 (see Figs. 6 and 7) comprises a generally cylindrical casing 73 and is formed to provide an integral passageway 74 at the lower side thereof which leads from the baffled passageway 71 to the central interior portion of the casing. The opposite ends of the casing are provided with cover members 75 and 76 which are secured thereto as by studs or other suitable means, and are provided

with screw-threaded central openings 77 and 78, respectively. An integral passageway 79 is formed at the right end of the casing and opens into the interior of the casing a short distance from the end thereof. Vertical walls 80 and 81 are formed in the central portions of the casing, respectively, separating the left and right end portions thereof from the passageway 74. Openings 80a and 81a, however, are formed in the walls 80 and 81, respectively, and a valve seat 82 is screwed into the opening 80a. A bore 84 is also formed in the wall 81, providing a piston rod bearing. The valve seat 82 is provided with a plurality of openings 85 and a central piece 86 having a bore 87 formed therein in alignment with the bore 84 and providing another piston rod bearing.

A valve device, indicated generally as 88, is disposed within the casing and includes a valve structure 89, a piston 90, and a piston rod 91. The valve structure 89 is adapted normally to rest on the seat 82 so as to close the openings 85 and includes a suitable circular plate member 92 and a seating disc 93. Central openings are formed in the plate member and seating disc, a suitable annular bearing 94 being fitted in the disc opening. A plurality of pockets 95 are formed in the plate member 92 and springs 96 are disposed to the pockets serving to constrain the disc 93 away from the plate 92. The piston 90 comprises a hollow cylinder 97 closed by an end member 98 and is adapted to be reciprocated in the right end portion of the casing. A central opening 99 is formed in the end member 98 and longitudinal ports 100 are formed through the piston.

The piston rod 91 extends through the central opening in the plate member 92 and is rigidly secured to the latter by a nut 101 and is slidably passed through the bearing 94 and the bores 87 and 84. The left end portion of the piston rod is of reduced diameter providing a shoulder 102, the reduced diameter corresponding to the inner diameter of the bearing 94 and central opening in the plate member 92, and the wider diameter of the portion of the rod adjacent this end portion corresponding to the diameter of the bore 87. By virtue of this arrangement and the springs 96, the disc 93 is held on the valve seat for a limited amount of movement of the piston rod and plate member away from the seat, that is, the differences of the diameters of the rod portions permit a predetermined amount of lost motion between the seating disc and piston rod upon movement of the latter to the left from its initial or normal position shown in the drawings, the seating disc being held by the spring 96 upon the valve seat until the rod has been moved sufficiently to the left for the shoulder 102 to engage it, whereupon it is moved with the plate and uncovers the valve openings 85.

The right end of the piston rod extends through the opening 99 in the end member 98 of the piston 90 and is rigidly secured to this member by a nut 103 so that the rod is movable with the piston 90 in both of its directions of reciprocal movement. A helical spring 104 is disposed around the right end portion of the rod 91 and bears at its left end against the wall 81 and at its right end against the end member 98 of the piston, so as to constrain the piston to the right and resiliently hold the valve device in the position shown in the drawings under normal conditions.

A pipe (not shown) may be secured in the opening 77, if desired, and lead to the atmosphere.

phere at a suitable location, or this opening may be simply left as shown. A pipe 106 is secured in the opening 78 in the right end cover member 76. The pipe 106 includes two branches 107 (see Fig. 4) which lead to the outlets 67 of the pumps 13, as shown. Suitable one-way valves, indicated at 108 are provided one in each of the branches 107 to permit the flow of water therethrough only in the direction from the pump to the control valve.

A pipe 109 is secured at the right end of the passageway 79 and leads to an opening 110 in the upper wall of the chamber 43 immediately adjacent the inlet opening 44, so as to be effectively directly connected with the return main of the heating system.

For controlling the operation of the motors 11 and, hence, the several pumps, the apparatus is equipped with two automatic electric control switches 111 (see Figs. 1 and 2) which are actuated by the level of the water in chamber 24, by means of floats 113 and an automatic electric control switch 112 which is actuated by predetermined vacuum or pressure limits within the system.

More particularly, the switches 111 and floats 113 are so arranged and adjusted that, when the water in the chamber portion 24 falls or recedes to or below a predetermined level, the floats operate the switches in such manner as to stop operation of the motors and, hence, the pumps 12 and 13, and, when the water rises to or above a certain predetermined level, the floats return the switches to their closed positions thereby to effect the operation of the motors and pumps. Thus, water is withdrawn from the receiver by the operation of the pumps 12 until the floats 113 fall to a position in which they so actuate the switches 111 as to cut off the motors and, hence, bring the pumps 12 to rest. The switches 111 then remain in these positions until such time as the condensate or water, which enters the chamber 43 from the system and is passed to the chamber 23, overflows through the opening 25 and the level of the water in chamber portion 24 is raised until the switches 111 are again actuated by their floats, as previously described, when the cycle of operation is repeated.

The switch 112 is of the pressure operated, diaphragm type, and is so arranged and adjusted that, when the pressure within the system rises, that is, the vacuum is reduced, beyond a predetermined value, it causes operation of the motors and, hence, the air ejector pumps 13, thereby to extract the air from the system through the valves 63, passageways 61 and chambers 55, regardless of the level of the water in chamber 23 or the positions of the switches 111. When the desired vacuum has been obtained the switch 112 operates to cut off the operation of the motors.

While in the preferred construction illustrated, both the air ejector pump 13 and the boiler feed pump 12 on each side of the apparatus are actuated by the same motor 11, if desired, these may, of course, be operated by individual prime movers, operated by any suitable source of power.

It will be seen from the foregoing description that in this preferred arrangement, both the air ejector pumps 13 and the boiler feed pumps 12 will be operated simultaneously, regardless of which of the switches closes the electric circuit. In other words, when the float switches 111 operate so as to close the electric circuit, due to a predetermined maximum level of the water in chamber 24 having been attained, the air ejector

pumps 13 as well as the water pumps 12 are operated, and the former effect a reduction in pressure within the system until such time as the water in chamber 24 has been brought to the desired minimum level. Conversely, when the vacuum control switch 112 is operated by virtue of the vacuum within the system having been reduced to a predetermined minimum to close the electrical circuit and operate the air ejector pumps, thereby to produce the desired reduced pressure, or higher vacuum, the boiler feed pumps 12 are also operated, regardless of the level of the water in chamber 24, and will continue to discharge water from the chamber 24 as long as the vacuum control switch maintains the electrical circuit of the motors in a closed position. If no water remains in the chamber 24 when the boiler feed pumps are thus in operation under the last-mentioned condition, however, the pumps merely idle, consuming practically no power, during this time, as the maximum vacuum desired is being obtained. Furthermore, these switches are preferably so constructed that the pumps may, if desired, be operated entirely under the influence of the level of the water in chamber 24, without regard to the pressure (vacuum) in the system by simply cutting out the vacuum control switch 112. A detailed description of the circuits and switches utilized for controlling the operation of the motors is unnecessary herein, since such apparatus is well known in the art, constitutes standard articles of commerce, and is not part of the present invention. Briefly, it may be stated that the function of this apparatus is to control the operation of the pumps at the proper times thereby to discharge the contents of chamber 24 when the water therein reaches a predetermined maximum level and to maintain a predetermined degree of vacuum in the system by extracting the air and vapors therefrom and discharging same to the atmosphere in the manner already described.

Referring now to the general operation of the apparatus, it will be assumed that the apparatus is employed in a steam heating system, with the return main of the system connected to the inlet opening 44. With the required vacuum in the chambers 43 and 21, the return products will be withdrawn from the return main, and entering the chamber 43 the water or condensate will pass down over the baffle 49 into the chamber 31, where any mud or other solid residue picked up in the system will be deposited. This may be removed from time to time, as mentioned above, through the opening 50. The water will flow from the chamber 31 through the screen member 47, and by way of the opening 45, the passageway 56, valve 58, chamber 55, and Venturi tube 66, into the inlet portion 23 of the receiving chamber 21. When the water in the inlet portion of the chamber rises to the opening 25 it flows into the main portion 24 of the receiving chamber, from which it is intermittently withdrawn by virtue of the action of the switches 111 and water pumps 12, as described above. Sufficient water, however, is, of course, always retained in the inlet portion 23 of the receiving chamber so as to furnish the water necessary for the operation of the air ejector pumps 13 so that they may function at all times.

Gas or air withdrawn from the return main of the system through the inlet opening 44 passes upwardly through the chamber 43 (see Fig. 5) and, by way of the valve 63, passageway 61, the

chamber 55 and Venturi tube 66, into the receiving chamber.

During the operation, just described, the valve device 33 of the automatic control valve 70 is in its so-called normal position, which is shown in Fig. 6. Thus, in this position, the passageway 74, which is open through the passageway 71 to the receiving chamber 21, is in free communication with the passageway 79, which latter is connected by the pipe 109 with the inlet chamber 43. The passageway or rather the valve openings 80a which lead to the atmosphere are cut off by the sealing disc 93 of valve structure 89. Thus, the pressures or vacuums within the receiving chamber 21 and in the inlet chamber 43, or at the end of the return main, are equalized and there is no restriction to the passage of the fluids to the receiving chamber, as described above.

When the motors are started, either by virtue of the water level in the chamber 21 rising above its critical level or the air pressure at the inlet opening rising above its critical value, the pumps will be automatically put in operation, as described above. Considering now particularly the functioning of the pumps 13, water is pumped thereby from the bottoms of the chambers 32 through the openings 68 (see Fig. 4) and by way of the pipes 69, into the inlets of the pumps 13, and, from the pump outlets 67, the water is forced through the ducts 64 and nozzles 65, across the suction spaces 55a and through the Venturi tubes 66 back to the receiving chamber. There is thus created at the spaces 55a, and consequently at inlet chamber 43, which is in direct communication therewith, the desired vacuum for operating the system. It will be seen, by virtue of this arrangement, that the water and gas or air in the return main will pass to the receiving chamber by way of separate or individual passageways and the operating vacuum will be applied to the system directly at the outlet thereof or end of the return main. Hence, in this apparatus the gases are not inefficiently drawn through water in a receiving tank, as in many vacuum pumping arrangements of the prior art.

Simultaneously with the last-described operation, that is, as soon as the pumps 13 begin to function, water is also forced through the pipe 109, by way of its branches 107 and the check valves 108 therein, into the right end portion of the casing of the automatic control valve 70. This water forces the piston 90 to the left, as shown in the drawings, against the resistance of the spring 104 and successively cuts off the passageway 79, by the piston 97 passing over its inner end, and moves the seating disc 93 of the valve member 89 off the seat 82, the latter action being delayed, from the initial movement of the valve device, until the shoulder 102 reaches the bearing 94. The passageway 74, and, hence, the receiving chamber 21, is thus connected to the atmosphere. Under this condition, therefore, the inlet chamber, which is under vacuum, is shut off from any communication with the receiving chamber through the pipe 109, and air from the receiving chamber is passed freely to the atmosphere. This arrangement is particularly advantageous in that, as distinguished from arrangements of the prior art, no additional chambers are required for the purpose of separating the returned gases and water.

When the desired conditions of water level and air pressure have been obtained, so that the motor and pumps automatically cease to operate, as described above, the water pressure behind the

piston 90 consequently drops and the spring 104 returns the valve elements to their normal positions. To the end that such return will not be delayed by the presence of water behind the piston 90, the ports 100 permit a leakage of water through the piston cylinder. It is to be noted, however, that when the piston is in its fully closed position these ports are closed by the seats 97a.

While the present invention has been described above in connection with an apparatus embodying a double or duplex pumping arrangement with various parts provided in duplicate, it will be obvious that an embodiment having a single pumping arrangement with only one of each of the various elements may be provided if desired. Such an arrangement would correspond to one-half of the apparatus described above, divided at the longitudinal center line thereof; and, of course, similar apparatus including more than two sets of motor and pumping arrangements may be readily constructed in accordance with this invention.

While there has been hereinbefore described the present preferred embodiment of the invention, it will be obvious to those skilled in the art that many and various changes and modifications may be made thereto without departing from the spirit of the invention, and it will be understood that all and any such changes and modifications are contemplated as a part of the invention as defined in the appended claims.

What is claimed is:

1. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber having outlets for gas and water, individual passageways for the flow of liquid and gas, respectively, from said inlet to said chamber, and means for producing a vacuum at said inlet while maintaining said chamber at atmospheric pressure to effect the flow of fluid through said passageways from said return main to said chamber while permitting the flow of gas through one of said outlets to the atmosphere.

2. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber, means for effecting the flow of liquid from said inlet to said chamber, and means independent of the last-mentioned means and including vacuum producing means for effecting the flow of gas from said inlet to said chamber.

3. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber, a passageway so connecting said inlet with said chamber as to permit the flow of liquid therethrough from said inlet to said chamber, a second passageway so connecting said inlet with said chamber as to permit the flow of gas while substantially preventing the flow of liquid therethrough, and vacuum producing means provided in connection with said second passageway for effecting the withdrawal of gases from said inlet and the delivery thereof through said second passageway into said chamber.

4. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber, individual passageways for the flow of liquid and gas, respectively, from said inlet to said chamber, means for producing a vacuum directly at said inlet to effect the withdrawal of gas from said return main and its delivery

through said gas passageway into said chamber, and means responsive to the pressure in said inlet for actuating said vacuum producing means when said pressure exceeds a predetermined value.

5 5. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber normally closed from the atmosphere, individual passageways for the flow of liquid and gas, respectively, from said inlet to said chamber, means for producing a vacuum directly at said inlet to effect the withdrawal of gas from said return main and its delivery through said gas passageways into said chamber, means for controlling the operation of vacuum producing means, and means responsive to the last said means and operable to connect said chamber with the atmosphere when said vacuum producing means is in operation.

6. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber normally closed from the atmosphere, individual passageways for the flow of liquid and gas, respectively, from said inlet to said chamber, valve means for each of said passageways adapted to prevent the flow of fluid from said chamber to said inlet, means for producing a vacuum directly at said inlet to effect the withdrawal of gas from said return main and its delivery through said gas passageway into said chamber, and means operable in accordance with the operation of the last said means to connect said chamber with the atmosphere during the operation thereof.

7. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber normally closed from the atmosphere, individual passageways for the flow of liquid and gas, respectively, from said inlet to said chamber, valve means for each of said passageways adapted to prevent the flow of fluid from said chamber to said inlet, means for producing a vacuum directly at said inlet to effect the withdrawal of gas from said return main and its delivery through said gas passageway into said chamber, and means operable in accordance with the operation of the last said means to connect said chamber with the atmosphere during the operation thereof and to connect said chamber directly with said inlet to equalize the pressures thereof when said vacuum producing means is inoperative.

8. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber normally closed from the atmosphere, individual passageways for the flow of liquid and gas, respectively, from said inlet to said chamber, valve means disposed in each of said passageways adapted to prevent the flow of fluid from said chamber to said inlet, means for producing a vacuum directly at said inlet to effect the withdrawal of gas from said return main and its delivery through said gas passageway into said chamber, means responsive to the pressure at said inlet for actuating said vacuum producing means when said pressure exceeds a predetermined value, and means operable in accordance with said vacuum producing means to connect said chamber with the atmosphere when said vacuum producing means is in operation.

9. A fluid pumping apparatus comprising an inlet adapted for connection with the return main

of a fluid circulating system, a fluid receiving chamber normally closed from the atmosphere, individual passageways for the flow of liquid and gas, respectively, from said inlet to said chamber, valve means disposed in each of said passageways adapted to prevent the flow of fluid from said chamber to said inlet, means for producing a vacuum directly at said inlet to effect the withdrawal of gas from said return main and its delivery through said gas passageway into said chamber, means responsive to the pressure at said inlet for actuating said vacuum producing means when said pressure exceeds a predetermined value, and means operable in accordance with said vacuum producing means to connect said chamber with the atmosphere when said vacuum producing means is in operation and to connect said chamber directly with said inlet to equalize the pressures thereof when said vacuum producing means is inoperative.

10. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber, a first passageway so connecting said inlet with said chamber as to permit the flow of liquid therethrough from said inlet to said chamber, a second passageway so connecting said inlet with said chamber as to permit the flow of gas while substantially preventing the flow of liquid therethrough, valve means for each of said passageways adapted to prevent the flow of fluid from said chamber to said inlet, pumping means provided in connection with said second passageway for effecting the withdrawal of gases from said return main through said inlet and the delivery thereof through said second passageway into said chamber, and means operable in accordance with the operation of said pumping means to connect said chamber to the atmosphere during operation thereof.

11. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber, a first passageway so connecting said inlet with said chamber as to permit the flow of liquid therethrough from said inlet to said chamber, a second passageway so connecting said inlet with said chamber as to permit the flow of gas while substantially preventing the flow of liquid therethrough, valve means for each of said passageways adapted to prevent the flow of fluid from said chamber to said inlet, pumping means provided in connection with said second passageway for effecting the withdrawal of gases from said return main through said inlet and the delivery thereof through said second passageway into said chamber, and means operable in accordance with the operation of said pumping means to connect said chamber to the atmosphere during operation thereof and to connect said chamber with said inlet to equalize the pressures thereof when said pumping means is inoperative.

12. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber, individual passageways for the flow of liquid and gas, respectively, from said inlet to said chamber, means in each of said passageways for preventing the flow of fluid therethrough from said chamber to said inlet, means for producing a vacuum directly at said inlet, and means including valve means automatically operable in response to the operation of said vacuum producing means adapted to connect said chamber with

the atmosphere during operation of said vacuum producing means.

13. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber, individual passageways for the flow of liquid and gas, respectively, from said inlet to said chamber, means in each of said passageways for preventing the flow of fluid therethrough from said chamber to said inlet, means for producing a vacuum directly at said inlet, and means including valve means automatically operable in response to the operation of said vacuum producing means adapted to connect said chamber with the atmosphere during operation of said vacuum producing means and to connect said chamber with said inlet to equalize the pressures thereof when said pumping means is inoperative.

14. A fluid pumping apparatus comprising an inlet adapted for connection with the return main of a fluid circulating system, a fluid receiving chamber, individual passageways for the flow of liquid and gas, respectively, from said inlet to said chamber, means in each of said passageways for preventing the flow of fluid therethrough from said chamber to said inlet, means for producing a vacuum directly at said inlet, and means, including valve means normally providing a connection between said chamber and said inlet to equalize the pressures thereof and automatically operable in response to the operation of said vacuum producing means to successively close said connection between said chamber and inlet and to connect said chamber with the atmosphere.

DAVID T. WILLIAMS.