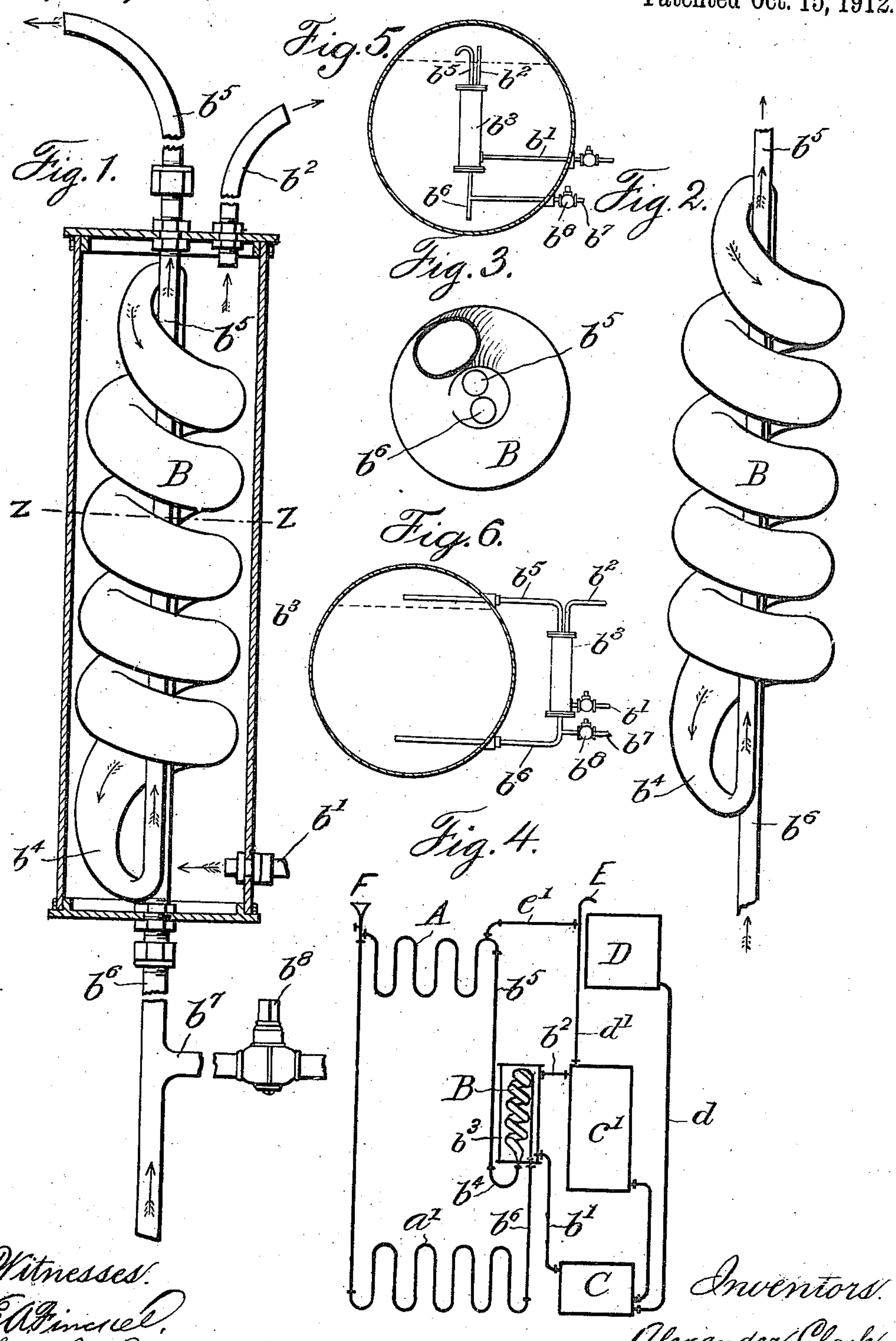
A. CLARK & J. J. FERGUSON.

MEANS FOR USE IN HEATING, PUMPING, AND CIRCULATING WATER AND OTHER FLUIDS.

APPLICATION FILED APR. 29, 1910.

1,041,429. Patented Oct. 15, 1912.



Witnesses:
E. A. Finckel.
Lillie M. Perry.

Inventors:
Alexander Clark.
John James Ferguson.
by Wm. H. Finckel
Atty.

UNITED STATES PATENT OFFICE.

ALEXANDER CLARK, OF GOVAN, AND JOHN JAMES FERGUSON, OF GLASGOW, SCOTLAND.

MEANS FOR USE IN HEATING, PUMPING, AND CIRCULATING WATER AND OTHER FLUIDS.

1,041,429. Specification of Letters Patent. Patented Oct. 15, 1912.

Application filed April 29, 1910. Serial No. 558,388.

To all whom it may concern:

Be it known that we, ALEXANDER CLARK, ship's plumber, of 37 Church street, Govan, in the county of Renfrew, Scotland, and JOHN JAMES FERGUSON, engineer, of 50 Wellington street, in the city and county of the city of Glasgow, Scotland, subjects of the King of Great Britain and Ireland, have invented certain new and useful Improvements in Means for Use in Heating, Pumping, and Circulating Water and other Fluids, (for which we have obtained a patent in Great Britain, No. 10,126, bearing date of April 29, 1909,) of which the following is a specification.

This invention comprises means for use in automatically heating, pumping, and circulating water and other fluids.

It has for certain of its specific objects to heat and pump water automatically, to pump water into and circulate it automatically within a steam boiler; also to heat and automatically circulate water contained in a series of inter-communicating heating pipes or radiators.

The invention will be understood if reference is made to the accompanying drawings, in which—

Figure 1 is a view partly in section, of our spiral pump within a steam or water jacket. Fig. 2 is a view in elevation of our worm-shaped or spiral pump. Fig. 3 is a cross view in section of Fig. 1 through Z Z. Fig. 4 is a diagrammatic view of our spiral pump in combination with an arrangement of heating and water circulating devices. Fig. 5 is a diagrammatic view of a steam boiler with the pump fixed within the boiler, and Fig. 6 is a similar view with the pump fixed outside of the boiler.

Similar letters of reference and numerals throughout the illustrations indicate corresponding parts.

The essential device comprised in this invention is a coil or worm-shaped tubular vessel constituting a pump, gradually diminished at each end by a conical taper into a small bore tube, similar to a trumpet, and which is designed for being operated automatically by externally applied heat. Each of these diminished ends is preferably formed as a curved, bent and conical continuation of the worm, and is extended as a straight line of tubing toward and beyond the opposite end of the worm or coil. Either or both of these straight tubes is made to pass along the outside or inside of this volute as indicated in the drawings. The lower or discharge end particularly of the worm is designedly tapered into a cone or trumpet shape, with upwardly turned, semicircular or bent continuation. This bent portion forms a trap or water seal for the coil, and by its curved continuation of the barrel or body part of the apparatus, facilitates the easy discharge of its fluid contents in an upward direction when it is in use as a pump. The fluid contents are forced upward through the straight extension tube. The upper end of the worm is also (and similarly) connected to a straight continuation tube which is extended downward as a suction or feed-water pipe. This coil or worm-shaped vessel or pump is designed to be fixed, variously, as required, within a jacket or chamber, wherein the coil can be subjected to powerful heat, either dry or moist. The said chamber may be a portion of a furnace flue, a hot-air chamber, a steam or hot water jacket, the interior of a boiler or other suitable location. The top of this spiral-bodied pump is fixed, for effective operation, below the level of its water service or supply tank, so that water may flow by gravitation through the supply or feed pipe into the upper part of the worm and proceed downward into its trap bend and conical base until its rise within the worm compresses the air or vapor therein, and prevents any further flow of water into it. The bent upper end of this coil continuation performs periodically the functions of an air trap, and at intervals prevents or arrests the passage of water from the feed pipe through it into the coil.

In the application of this invention to the circulation of water through pipes and radiators, such as those marked A, a', Fig. 4, for warming tiers and suites of apartments, the jacket b^3 of this pump B is connected by pipes b', b^2, intermediately between a high pressure boiler C and a circulating cylinder c' (or the like), and a water cistern or service, so that when fire is applied thereto the hot water from the boiler C passes through the said jacket b^3 before it proceeds to the circulating cylinder c' and heats the metal coil. The pump itself communicates indirectly through the pipes b^5 and e' with an expansion cistern D, and directly with a set of heating pipes or radiators A, a'. The jacket b^3 is connected directly with the boiler C and cylinder c', and indirectly with the cistern D, by feed pipe d connecting cistern D with the boiler C, and expansion pipe d' connecting circulating cylinder c' with the expansion cistern D. Escapement pipe E is connected as usual to the expansion pipes e' and d' of the radiators and circulating cylinder, the pipe e' serving as a vent for the upper bend of the pipe b^5.

When the heating pipes or radiators, such as those marked A, a', Fig. 4, are filled with water from the part F or the like, the water first flows through the radiator a' and the pipe b^6 to and through the pump B, in drops or a broken-up condition, due to the larger capacity of the pump, and then into the trap b^4 of the pump and seals it. The air which has been forced out of the radiator a' and pipe b^6 is confined within the pump B between the water seal in the trap b^4 and the water in the upper part of the feed pipe b^6. As the water continues to fall or flow in a broken-up condition from the pipe b^6 into the pump B, it gradually rises therein and in the pipe b^5, after its trap is sealed, and the air confined in the coil or pump becomes more and more compressed until the inflowing water at the top from pipe b^6 is completely arrested by the confined and compressed bubble or plug of air, as the bent upper part of the pipe b^6 then becomes an air trap. Water then flows from F through radiator A into pipe b^5, and thus increases the compression of the air in pump B. When the system is sufficiently filled with water the supply at F is cut off or stopped, and there is no pressure maintained on the water contained in the system.

When the water in the boiler C is sufficiently heated the usual circulation is set up between the boiler and the circulating cylinder c'. As the hot water from the boiler C passes through the pipe b' and jacket b^3 the metal body of the spiral B becomes very hot and the air and vapor within it expand until the water in the pump and the water seal in the trap b^4 is forced forward through the said trap and upward through the pipe b^5 to the radiator A. The water is prevented from being forced back into the feed pipe b^6 by reason of the greater volume and consequent momentum of the column of water in pipe b^6, radiator a' to the filling part F, with which it sustains an unbroken connection, and added to which is the frictional resistance of the bends of the radiator a'. Therefore, the column of water in pipe b^5 to open vent pipe e' is opposed to the column of water from the filling part F and in radiator a', through pipe b^6, the column from the filling part F to radiator a' alone being greater than the column in pipe b^5, and the air confined in the pump B acts as a buffer to each. When the air in the pump expands by the heat applied thereto, it is opposed by the water in pipe b^6 by a resistance equal to or more than twice the resistance in pipe b^5 when pipe b^5 is full. Pipe b^5 is never full after the first pulsation of the pump there being an air space in the upper bend at the vent e' and between the column of water in radiator A and the column of water in pipe b^5. Therefore, there is always least resistance by the water in pipe b^5 and the air pressure in the pump easily forces the water from within the pump upward through pipe b^5 until it obtains vent or passes through the air space in the upper part of pipe b^5 and an equilibrium is attained and the pressure ceases. The pipe b^5 is only once full of water and that is at the starting of the apparatus, and upon the first pulsation of the pump its surplus of water cannot find escape through radiator A into filling part F, it being closed, but is forced through pipe e' into the tank or supply cistern D and cannot return. When the pressure of the pump ceases and has forced some of the water from pipe b^5, the air in the pump is between unequal pressures, the pressure at the inlet being the greater, and consequently there is a quicker flow of water from pipe b^6 than from pipe b^5 into the pump B until an equilibrium of pressure at the inlet and outlet is reached. Compression of the air in pump B again takes place due to the water rising in the lower part of the pump, and as the pulsations continue a slight evaporation takes place through the open vent pipe e', so that the pipe b^5 is never again full of water after the first pulsation, but its column of water is imperceptibly diminishing while the heat and operation of the pump are maintained. Refilling at F is required as the water evaporates. The column of water in the pipe F and radiator a' never varies, it being continuously supplied by circulation through radiator A and maintains an equal resistance upon the inlet side of the pump, while the pipe b^5 maintains only the resistance of its varying column of water due to the break between the radiator A and said pipe, by the air space therein at the vent e'. The filling of pipe b^5 is from F only, and there is always an occasional or intermittent siphoning action at the junction of F with radiator A, when the apparatus is in operation, and this causes the water to fall back simultaneously at the junction of pipe b^5 with radiator A leaving the air space therein which is open to the atmosphere through vent pipe e'. This is due to the greater column in pipe b^6, radiator a' and filling part F than in radiator A, from F, including vent e', E, the column in pipe b^5 being isolated from the column in radiator A and filling part F by the air vent e' and E, the surplus water in the pipe b^5 at the start being vented through the pipe e' to cistern D. Thereafter there is always some water in the pipe b^5 and a variable quantity of air will find its way to the upper bend of pipe b^5 due to the open pipe e'. The air pressure within the pump while thus expelling the water through the trap and pipe, b^4 and b^5 respectively, prevents for a time any more water flowing through the bent head of the pipe b^6 into the coil. This expansion of air continues until the air pressure is less than the hydrostatic head of the water remaining in pipe b^5. The air pressure is then less than the hydrostatic head at the inlet to the pump, and colder water drops from the feed pipe b^6 into the pump partially cooling and contracting the air within the pump.

As the cooler water flows in at the top of the pump, the undischarged water remaining in the pipe b^5 simultaneously flows back therefrom through the trap b^4 into the pump. Or, in other words, as the water is forced out of this pump, the air space within the pump is increased and the expelling power of the heated air reaches an end before the water can be vented from the trap. An equilibrium is then set up momentarily between the air pressure and the water pressures in the pipes b^6 and b^5. Upon the slightest disturbance of this equilibrium and as there is less resistance offered by the reduced column of water in the pipe b^5 due to some of the water being discharged therefrom, the water in the pipe b^6, which from the start has a greater resistance (more than double) than in the pipe b^5, begins to flow and slightly cools the air within the pump and reduces its bulk, expansive and expulsive power. From F to the upper bend of pipe b^6 the radiator a' and pipes are always full of water as above stated, but the shorter pipe b^5 is never full after the first pulsation, and thus a greater resistance is maintained in the feed pipe b^6. Water simultaneously begins to flow back from the pipe b^5 into the pump after each expulsion, and combines with the water flowing or dropping in at the upper end of the pump from pipe b^6, and a vapor or humid atmosphere enters the top of b^5 through vent pipe e'. The air within the pump becomes, after a pause, again compressed, and is then again expanded by the heat in chamber b^3, and again expels the water from the pump and trap through pipe b^5 into radiator A and from radiator A to feed pipe leading from F to radiator a', and the air is again partially cooled and condensed. This pumping process is continued at intervals so long as the heat is maintained in the boiler C. This heat is absorbed by the water and is partially lost as the water circulates through the radiators. The temperature of the water is much reduced by influence of the radiators before the water reënters the coil or pump B. When the water is first filled at F into the radiators A, a', it is cold, but as it circulates through the hot pump B it becomes gradually heated by contact with its hot spiral-shaped metal surface and the hot air within it. The spiral form of this pump body presents a very large metal surface for receiving and transmitting heat to the air and liquid contents within it. This spiral form of the pump B is designed and adapted for rapidly raising the temperature of the atmosphere within the pump. The pump ceases its operations, automatically, when the air in the pump and the heating medium are at the same temperature and the water in the feed and exhaust pipes and the air in the pump are in equilibrium, and commences to act, automatically, when these conditions are disturbed. The jacketed pump B, b^3, in conjunction with a boiler C and appliances c' and D, as represented in Fig. 4, is adapted and designed, also, for automatically raising, pumping, and discharging water as well as for circulating it within such confined areas as radiators where it is required to travel in a cycle.

The jacketed pump B, b^3, Fig. 1, is designed and adapted for attachment to any convenient part, within or outside, of a steam boiler or generator where its feed and discharge pipes b^6 and b^5 are extended so as to communicate respectively with the lower and upper parts of the boiler, and the pipe b^7 with the cock b^8 is designed to be connected externally with a feed water tank or the like outside of it.

If the jacketed pump B, b^3, is fixed within a steam boiler, as shown in Fig. 5, the pipes b' and b^7 are extended through the shell of the boiler to the outside thereof, and the pipe b^2 is open to the steam space within it. It is designed to be operated within a steam boiler as a feed pump when required by means of steam supplied from some source external to the boiler through the pipe b', also as a circulator of the water within the boiler by means of the same external supply of steam while the water within the boiler is at a low temperature. The supply of steam through the external pipe b' is designed to be cut off from the chamber b^3 when the heat within the boiler is sufficient of itself to operate the pump B. When the pipe b^2 is open to the steam space and pressure within the boiler and the steam is cut off at b', the steam within the boiler can enter through the pipe b^2 and fill the chamber b^3 and operate the pump B.

When the jacketed pump B, b^3, Fig. 1, is fixed outside of a steam boiler, as shown in Fig. 6, the pipes b^5 and b^6 can be passed through the shell of the boiler to the interior thereof, and the pipes b', b^2, connected with the steam space of a high pressure boiler, and an exhaust tank or cylinder, corresponding to those marked C, c', Fig. 4, or the like, and the pipe b^7 is connected with any suitable feed water tank or supply and with the feed pipe b^6. If steam from any convenient source is fed through b' into the chamber b^3 it suffices, when the cock b^8 is closed, to operate the pump B as a circulator only. When the cock b^8 is open the apparatus is adapted for operation as a feed water pump for the boiler.

The pump B alone, with its pipes b^5, b^6 and b^7, without the jacket b^3 and its pipes b', b^2 may be fixed within a steam boiler and operated by the heat of the water within it as a feed water pump when the cock b^8 is open, and as a circulator when it is closed. The whole of the worm B is fixed below the high water level within the boiler for the purposes herein described. The spiral pump B is also designed to be fixed outside of a steam boiler and within some adjacent place, chamber, or jacket where it can be subjected to a dry heat, and its pipes b^5, b^6, extended through the plates or shell of the boiler into the interior thereof for use as a feed pump and circulator alternately as required. In these several installations of the pump, the pipe b^5, opening freely into the steam space of the boiler, serves the purpose of venting the upper part only, not the whole, of said pipe, the same as the pipe e' in the first-described arrangement.

We are aware that, previous to our invention, tubular air and vapor containing vessels have been combined with steam boilers internally for automatically circulating the water therein, wherein the actuating agent for preventing and promoting, arresting and discharging the flow of water was air and vapor alternately expanded and compressed by varying degrees of heat and pressure derived from the temperature of the water within the boiler and the said vessel. It will therefore be understood that we do not claim such a method of operating a pump or circulator for water as our invention.

What we claim is:—

1. In combination, a heating chamber, having inlet and outlet openings, an automatic tubular liquid pump arranged in said chamber and comprising a capacious, spiral-shaped, central air-chamber, having a small-bore inlet pipe at the top extended downward below the spiral, and an outlet at the base having a trap-bend, and a small-bore discharge pipe extended upward from said trap-bend above the spiral, as and for the purposes herein set forth.

2. An automatic tubular liquid pump adapted to be arranged in a heating chamber, comprising a wide-bore, spiral-shaped air-chamber terminating at the top in a small-bore inlet pipe extended downward below the spiral, and a tapered base having a trap-bend therein, and a small-bore discharge pipe extended upward from said trap-bend above the spiral, as and for the purposes herein set forth.

3. An automatic tubular liquid pump, adapted to be arranged within a heating chamber, comprising a capacious air chamber having an inlet pipe at the top and an outlet pipe at the bottom, substantially as and for the purposes herein set forth.

ALEXANDER CLARK.
JOHN JAMES FERGUSON.

Witnesses:
JOSEPH LOCKWOOD,
FRED MIDDLETON.