

Sept. 13, 1966

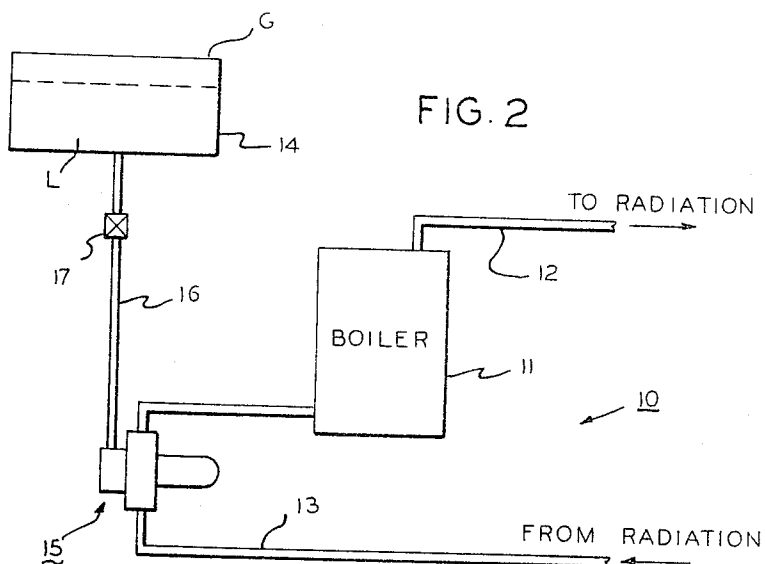
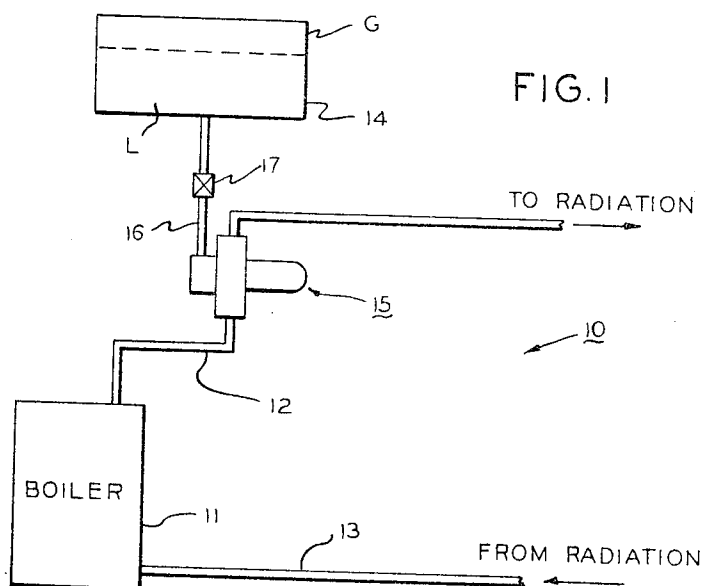
J. H. HARKER ETAL

3,271,933

GAS SEPARATION PUMP FOR LIQUID CIRCULATING SYSTEMS

Filed Oct. 31, 1963

3 Sheets-Sheet 1



INVENTORS
JACK KEYES
JOHN H. HARKER
BY ERWIN L. OEHLERKING
Erwin L. Oehlerking
ATTORNEY

Sept. 13, 1966

J. H. HARKER ETAL

3,271,933

GAS SEPARATION PUMP FOR LIQUID CIRCULATING SYSTEMS

Filed Oct. 31, 1963

3 Sheets-Sheet 2

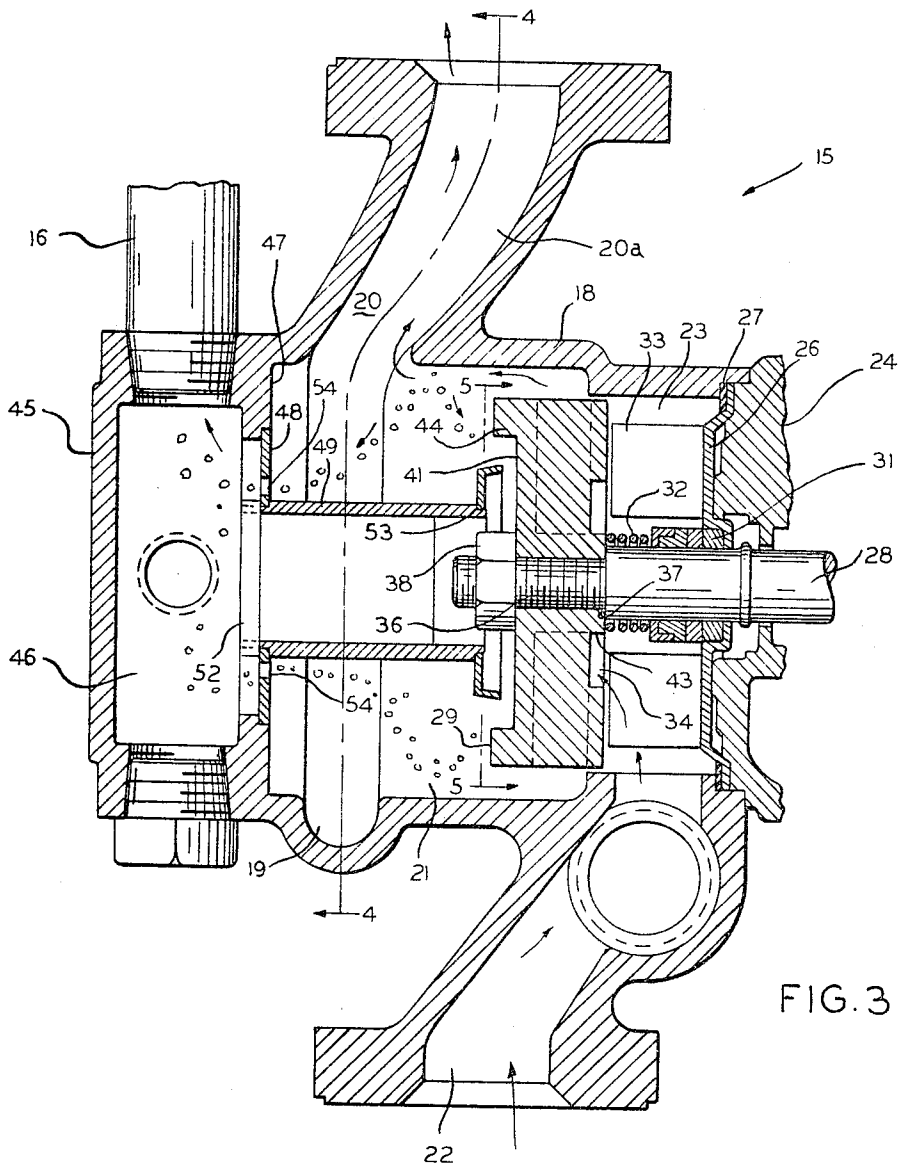


FIG. 3.

INVENTORS
JACK KEYES
JOHN H. HARKER
BY ERWIN L. OEHLECKING

Chas. Lindberg

ATTORNEY

Sept. 13, 1966

J. H. HARKER ET AL

3,271,933

GAS SEPARATION PUMP FOR LIQUID CIRCULATING SYSTEMS

Filed Oct. 31, 1963

3 Sheets-Sheet 5

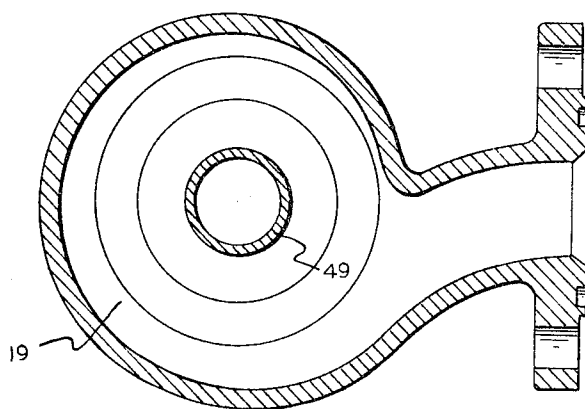


FIG. 4

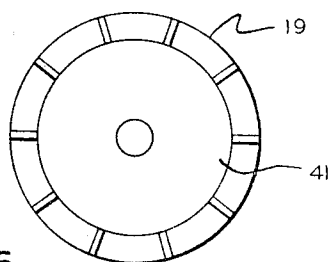


FIG. 5

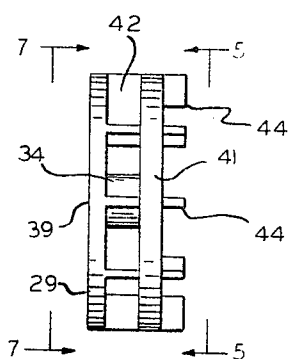


FIG. 6

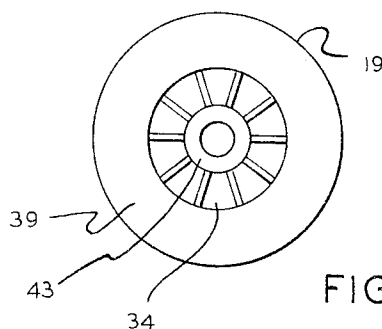


FIG. 7

INVENTORS
JACK KEYES
JOHN H. HARKER
BY ERWIN L. OEHLERKING

Erwin L. Oehlerking
ATTORNEY

1

3,271,933

GAS SEPARATION PUMP FOR LIQUID
CIRCULATING SYSTEMS

John H. Harker, Park Ridge, Erwin L. Oehlerking, Des
Plaines, and Jack Keyes, Park Ridge, Ill., assignors, by
mesne assignments, to International Telephone & Tele-
graph Corporation, New York, N.Y., a corporation of
Maryland

Filed Oct. 31, 1963, Ser. No. 320,414

3 Claims. (Cl. 55-203)

This invention relates generally to liquid circulating systems such as hot water heating and chilled water cooling systems of the forced circulation type, and has particular reference to improvements in system circulating pumps having the additional function of separating gases from the circulating liquid.

Heretofore, and particularly in closed pressurized hot water heating systems it has been necessary to provide structure for trapping gases released from the circulating water, these gases being trapped in a tank also providing a reservoir for the water as it expands and contracts. For example, in the systems of the prior art it has been necessary to provide suitable structure at the boiler for separating out such released gases and directing them to the expansion tank where similar structure is provided to complete the separation of the gases from the water.

According to the present invention, it is unnecessary to provide structure as previously described, the separation being accomplished by a system circulating pump constructed in a unique fashion and connected into the system.

With the foregoing considerations in mind, it is a principal object of this invention to provide an improved hot water heating or chilled water cooling system characterized by a circulating pump having structure therein for causing separation of entrained gases in the water, and for diverting the same to structure where the separation is completed.

Another object is to provide in a pump for such system, structure for separating gases from the water and to cause the separated gases to be diverted into a separating chamber made as part of the system.

Still another object is to provide a circulating pump for a hot water heating or chilled water cooling system, said pump having structure for enabling entrained gases to be separated at the delivery side of the pump, and to be diverted into a chamber at the delivery side thereof prior to being further diverted to the conventional expansion tank of such system.

Other objects and important features of the invention will be apparent from a study of the following specification taken with the drawings, which together describe and illustrate a preferred embodiment of the invention, and what is now considered to be the best mode of practicing the principles thereof. Other embodiments may be suggested to those having the benefit of the teachings herein, and such other embodiments are intended to be reserved especially as they fall within the scope and spirit of the subjoined claims.

In the drawings:

FIG. 1 is a schematic view showing a hot water heating system having the improvements according to the present invention embodied therein;

FIG. 2 is a view similar to FIG. 1, but showing an alternate way of connecting the air separating pump into the system;

FIG. 3 is a vertical section taken through a circulating pump of the systems of FIGS. 1 and 2, said pump having the improvements according to the present invention embodied therein;

FIG. 4 is a sectional view taken along the lines 4-4 of FIG. 3, looking in the direction of the arrows;

FIG. 5 is a front elevational view of the impeller em-

2

ployed with the pump seen in FIG. 3, said view looking in the direction of the arrows 5-5 of FIG. 3;

FIG. 6 is a side elevational view of the impeller seen in FIG. 3; and

FIG. 7 is a back elevational view thereof looking in the direction of the arrows 7-7 of FIG. 6.

Referring now particularly to FIG. 1 of the drawings, the improvements in hot water heating systems according to the present invention are best seen with respect to a liquid circulating system such as a hot water heating system referred to generally by the reference numeral 10, and including a boiler 11 having a supply main 12 connected to suitable heat exchange means such as radiation, not shown, and a return main 13 similarly connected to such radiation. In order to produce circulation in the supply and return mains 12 and 13, a pump indicated generally by the reference numeral 15 is connected in the supply main 12. One of the features of the present invention is the provision in the pump 15 of structure for separating gas, usually air, from the system water, such entrained gas being separated by the pump 15 and led from pump 15 to an expansion tank 14 by a line 16.

As seen in FIG. 1, the expansion tank 14 has a supply of water L therein, the quantity of which varies according to the expansion or contraction of the water in the system. A quantity of entrapped gas G is maintained under pressure above the level of the water L in the tank 14.

The line 16 may have a vent 17 therein, which is operative when all the liquid is returned from the tank 14 to the system, the valve 17 venting excess gas, and enabling the liquid to move to the tank 14 upon expansion thereof.

Referring now to FIG. 2 of the drawings, there is shown a system similar to that seen in FIG. 1, the difference being that the pump 15 is connected in the return line 13 to the boiler 11 instead of being connected to the supply main 12. Irrespective of the mode of connection of the pump 15, it is provided with structure whereby gas is separated from the circulated liquid to be directed to the tank 14, said tank having a quantity of gas G held under pressure above the level of the water L in the tank 14. Also, the line 16 connecting the pump 15 to the tank 14 is provided with valve means 17 for bleeding excess gas from the tank 14, so as to permit the tank 14 to store a quantity of the expanded water L.

Referring now to FIGS. 3 and 6 of the drawings, the pump 15 seen in FIG. 1 is of the centrifugal type and includes a pump body 18 which is formed integrally with pump output chamber 19, see also FIG. 4, which pump output chamber 19 may be considered as being composed of a discharge chamber 20 and a dynamic separating chamber 21. Discharge chamber 20 is coextensive with a discharge passageway 20a which is formed in the pump body 18. The pump housing 18 has an entrance passageway 22 to a pump inlet chamber 23, closed by an end bell 24 secured to the pump body 18 in any convenient manner. A shaft seal supporting member 26 carries an annular gasket 27 at the periphery thereof to effect a seal between the pump body 18 and the end bell 24. A drive shaft 28 for a pump impeller 29 extends through the inlet chamber 23, and the seal supporting member 26 supports a pump seal 31 which has the proper biasing pressure maintained thereagainst by the bias of a spring 32 held between the entrance side of the impeller 29 and the seal 31, which is bottomed against the shaft seal supporting member 26.

The shaft seal supporting member 26 has a plurality of radial baffles 33 extending therefrom, which serve the purpose of straightening the flow of the water entering the pump 15 by the entrance passageway 22, the entrant water being then directed to an eye 34 of the pump impeller 29.

The pump impeller 29 is held on a threaded reduced diameter portion 36 of the pump shaft 28, the impeller 29 being held between a shoulder 37 formed on the shaft 28 and a clamping nut 38 threaded to the end of the reduced diameter portion 36.

Referring now particularly to FIGS. 5 to 7 of the drawings, the impeller 29 has its entrance throat 34 formed in a back wall 39 thereof. The back wall 39 is spaced from a front wall 41, and the back wall 39 and the front wall 41 are connected by pumping vanes 24 which extend radially from a central hub 43. As seen in FIG. 6, the front wall 41 of the impeller 29 has small pumping ribs 44 which extend radially inward from the peripheral portions of the front wall 41 to give an additional rotating or swirling effect to the pumped liquid.

Structure is provided for separating gas entrained in the pumped liquid, and directing the separated gases from the pump 15 and into the expansion tank 14 described with reference to FIGS. 1 and 2 of the drawings. The pump body 18 is accordingly formed with an integral housing 45 defining a fluid collecting and gas collecting static chamber 46 which is separated in part from the discharge chamber 20 and dynamic separating chamber 21 by a wall 47. The wall 47 thus flanks the discharge chamber 20. The wall 47 affords a support for a partition 48 which is pressed or otherwise secured to the wall 47, the partition 48 supporting a tubular member 49 which is co-axial with the axis of rotation of the pump impeller 29. The tubular member 49 may be secured in any convenient fashion to the partition 48, and the end of the tubular member extending into the chamber 46 defined by the partitions 47 and 48 and housing 45 may include a ring 52 which holds the tubular member 49 to the partition 48 as seen in FIG. 3.

The end of the tubular member 49 adjacent impeller 29 is spaced somewhat from the back face 41 thereof, and the end of the member 49 adjacent to the impeller 29 may be fitted with a flange-like collector member 53 which is also spaced from the front face 41 of the impeller 29, and which serves to guide gases separated from the pumped liquid, in a manner as will be described.

Partition 48 may additionally be provided with a plurality of openings 54 spaced around the passageway 49.

In the operation of the pump just described, there is a pressure gradient which varies from a maximum at the peripheral portions of the dynamic separating chamber 21 to a minimum at the center of rotation of the impeller rotating within such chamber. The pumping action of the impeller thus compresses any entrained gases in the liquid stream, and such entrained gases will tend to move to the portions of the volute housing having the lower pressures therein.

In addition, there is a normal centripetal accelerating force acting upon the lighter gaseous elements forcing them toward the center of rotation of the rotating fluid in the dynamic separating chamber 21. Accordingly, the liquid pumped by the impeller 29 into the dynamic separation chamber 21 will at the same time pump the gases which are entrained in the liquid, and by reason of the fact that the entrained gases will tend to move to the center of rotation of the impeller 29, as compared to the movement of the liquid, and toward the portion of chamber 21 where the pressure is at a minimum, said gases will expand as the pressure thereon diminishes.

Accordingly, the mixture of water and entrained gases leaving the peripheral portions of the impeller 29 will move first to the dynamic separation chamber 21, where the separation of the gases from the liquid commences, the pumped gas detained liquid leaving the pump housing by the passageway 20a. The gases, however, in their detaining process will move radially inward, and will extend as an annular column along the outer surface of the tube 49, being expanded as the gases move radially inward. Those gases collected along the outer surface of tube 49 move into the gas collecting static chamber 46

by way of the openings 54 spaced around tube 49 and located in partition 48. The mixture of expanded gases and liquid collected in the gas collecting static chamber 46 can move therefrom by way of the line 16 which may be connected to the expansion tank 14.

In addition, circulation of gas-free liquid is achieved along the inside of tube 49, there being a pumping action induced therethrough by the disk friction of the face 41 of impeller 29 in contact with the liquid.

It will be seen from the description foregoing, that there has been provided some new and useful improvements in liquid circulating systems including chilled water cooling and hot water heating systems, and also in circulating pumps for such systems. In the system disclosed, and the pump employed therewith, it is not necessary, for example, to have gas separating fittings at the boiler, such gas separation being achieved by the pump alone, and such gas separation being provided as an integral part of the pump.

Having thus described the invention in such full, clear, concise and exact terms as to enable one skilled in the art to make and use the same, and having set forth the best mode contemplated of carrying out the invention, the subject matter of the invention is particularly pointed out and distinctly claimed, it being understood that equivalents or modifications of, or substitutions for, parts of the above specifically described embodiment of the invention may be made without departing from the scope of the invention as set forth in what is claimed.

We claim:

1. A centrifugal pump particularly adapted to separate gases entrained in the liquid pumped thereby, said pump comprising a housing having a dynamic separating chamber and a pump discharge chamber, a pump impeller rotating in said dynamic separating chamber, supply and discharge passages to said housing, means defining a fluid collecting and gas collecting static chamber flanking said pump discharge chamber, a partition between said pump discharge chamber and said fluid collecting and gas collecting static chamber, and means providing a passageway from said dynamic separating chamber to said fluid collecting and gas collecting static chamber for the movement of gases so as to separate said gases from the pumped fluid, said means comprising a hollow tube coaxially arranged with respect to said impeller and extending from said static chamber to a point close to said impeller, means in said partition for the movement of gases into said fluid collecting and gas collecting static chamber, said hollow tube providing a return passageway within said pump housing through which liquid which has been detained of gas may move.

2. A centrifugal pump particularly adapted to separate gases entrained in the liquid pumped thereby, said pump comprising a housing having a dynamic separating chamber and a pump discharge chamber, a pump impeller rotating in said dynamic separating chamber, supply and discharge passages to said housing, means defining a fluid collecting and gas collecting static chamber, a partition between said pump discharge chamber and said fluid collecting and gas collecting static chamber, and means providing a path from said dynamic separating chamber to said fluid collecting and gas collecting static chamber for the movement of gases so as to separate said gases from the pumped fluid, said means comprising a hollow tube supported by said partition and extending therefrom to a point close to said impeller, said hollow tube being coaxially arranged with respect to the turning axis of said impeller and providing a zone of lowest pressure within said dynamic separating chamber within which gas detained liquid may move, and openings in said partition spaced about said hollow tube for expanding gases moving along the outside of said hollow tube and into said fluid collecting and gas collecting static chamber.

3. A centrifugal pump particularly adapted to separate gases entrained in the liquid pumped thereby, said pump

5

comprising a housing having a dynamic separating chamber and a pump discharge chamber, a pump impeller rotating in said dynamic separating chamber, supply and discharge passages to said housing, means defining a fluid collecting and gas collecting static chamber flanking said pump discharge chamber, a partition having openings therein between said pump discharge chamber and said fluid collecting and gas collecting static chamber, and means providing a passageway from said dynamic separating chamber to said fluid collecting and gas collecting static chamber for the movement of gases so as to separate said gases from the pumped fluid, said means comprising a hollow tube supported by said partition and extending coaxially with respect to the axis of rotation of said impeller therefrom to a point close to said impeller, said hollow tube providing a zone of low pressure within said pump housing toward which gas detrained liquid

6

may move, and a flange supported by said hollow tube adjacent said pump impeller.

References Cited by the Examiner

UNITED STATES PATENTS

2,736,266 2/1956 Eisele.
3,036,779 5/1962 Hansen ----- 237—63

FOREIGN PATENTS

567,741 12/1958 Canada.

REUBEN FRIEDMAN, *Primary Examiner.*

JOHN M. MICHAEL, *Examiner.*

R. W. BURKS, V. M. PERUZZI, *Assistant Examiners.*