

Nov. 21, 1939.

E. S. CORNELL, JR

2,180,401

WATER CIRCULATOR

Filed Aug. 4, 1937

2 Sheets-Sheet 1

Fig. 1.

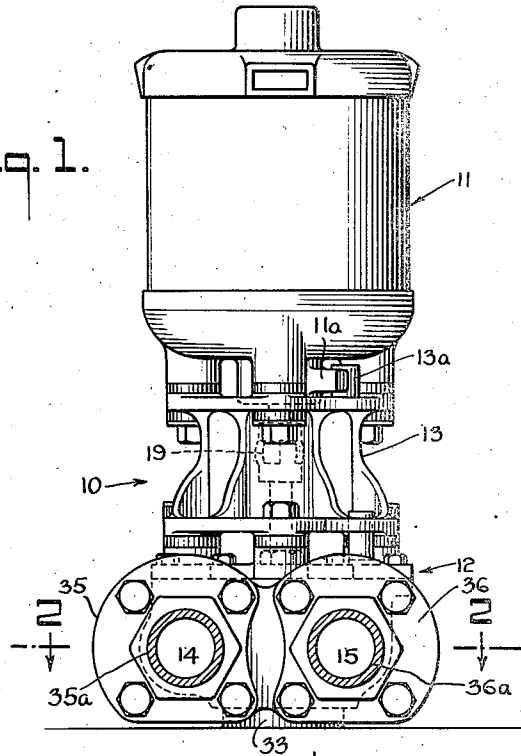
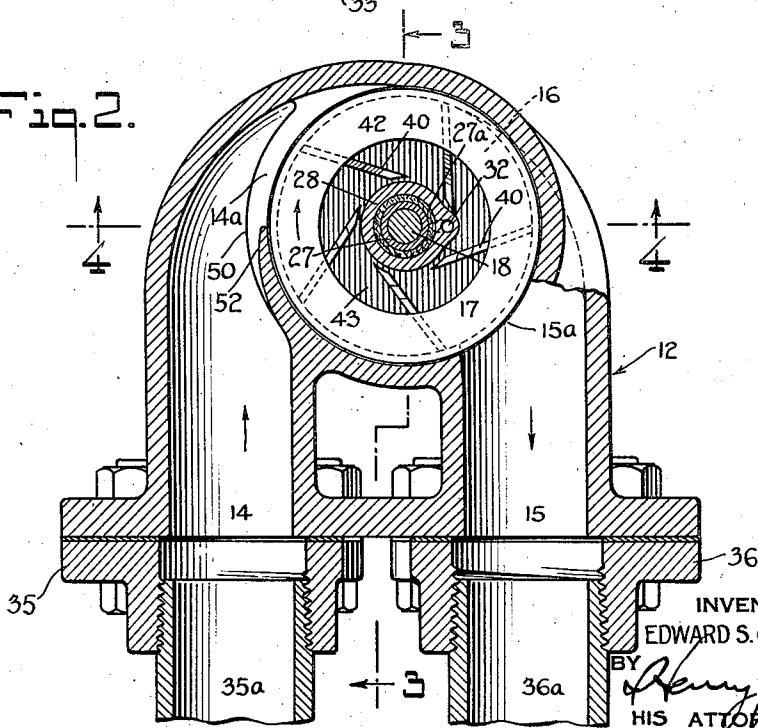


Fig. 2.



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2 Sheets-Sheet 2

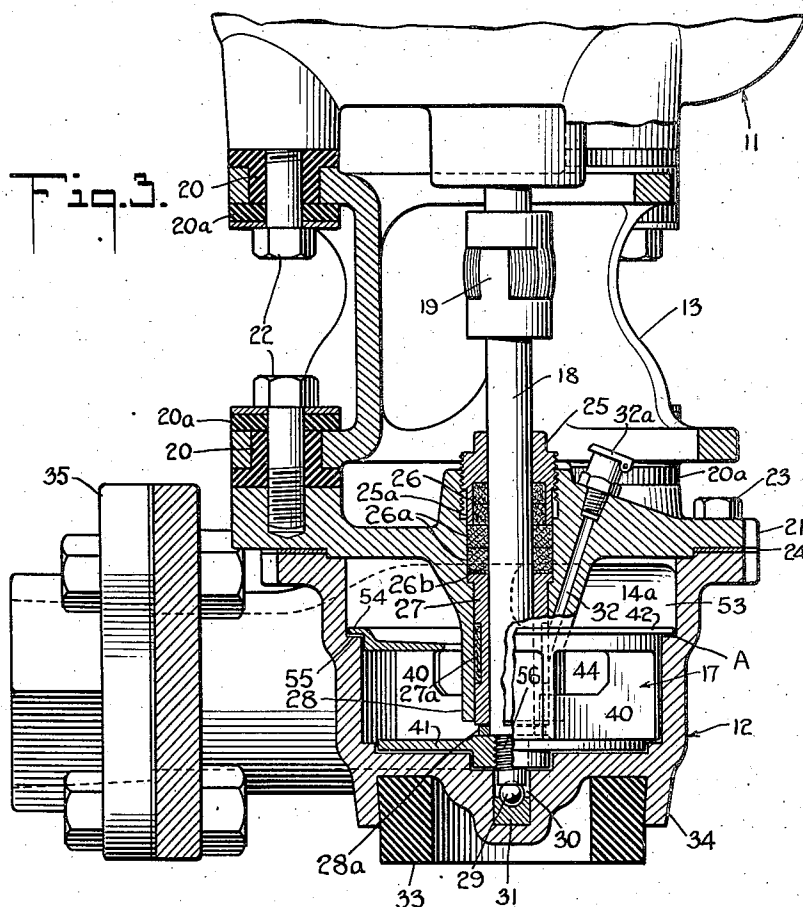
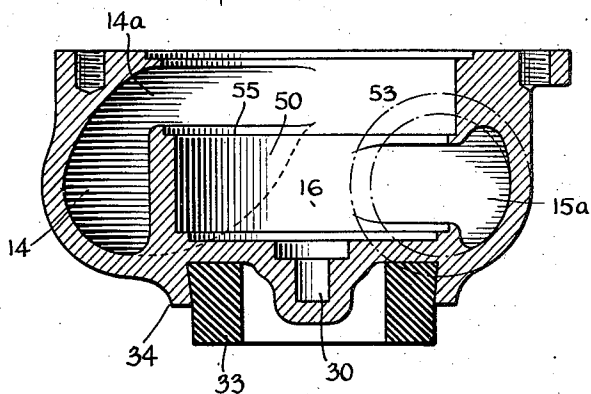


Fig. 4.



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UNITED STATES PATENT OFFICE

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WATER CIRCULATOR

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3 Claims. (Cl. 103—103)

This invention relates to centrifugal pumps.

The invention is directed to improvements in centrifugal pumps, and has for its object, broadly, an improved pump particularly suitable for service in heating systems employing circulation of hot water or other heat-containing liquid through a closed piping system incorporating a heat generator or "boiler" and one or more "radiators."

More specifically, objects of the invention include: provision of an improved pump casing, arranged to impart an initially rotative direction to the inflowing liquid prior to its passage through the eye of the impeller, thus bringing the liquid into contact with impeller substantially without shock, eliminating noise-producing vibrations, and increasing efficiency; provision for an ample reservoir above the impeller, to quiet turbulences in the incoming liquid prior to its introduction to the impeller; provision for the location of inlet and discharge ports at one side of the pump casing, to compact the pump and thus facilitate its location within the boiler housing or jacket; and provision for a vibration-dampening mounting or base on which the entire pump structure may be supported.

In this invention, the centrifugal pump includes a generally U-shaped pump casing, arranged for horizontal mounting, with inlet and outlet passages forming the branches of the U, and thereby being adjacent; a source of motive power resiliently mounted on the said casing; and a centrifugal impeller arranged for rotation within a race at the base of the U.

It is a feature of the invention that the impeller race is eccentrically located within the casing, that is, is located in the general direction of the discharge passage. Such location of the impeller race imparts definite advantages, namely, the provision of a relatively large capacity at the inlet side, as compared with the volume at the discharge side, such enlarged capacity acting to reduce turbulences in the inflowing liquids; and the provision of an improved organization of elements at the inlet side, for imparting to the inflowing stream a gradual change in its direction of flow and a concomitant increase in the velocity of the inflowing stream at its introduction to the impeller. The stream is thereby brought into contact with the impeller in a direction substantially tangential to the circle of rotation of the impeller, and at increased velocity, thus minimizing vibration and wear-causing shock which ordinarily results in centrifugal pumps from a sudden change in direction and/or

velocity in the inflowing stream as it approaches the impeller.

Yet another feature is that the initial rotative direction imparted to the stream by the inlet configuration cooperates advantageously with the backward-discharge angle of the impeller blades, said blades cutting into the stream at an acute angle, and thus without creating excessive vibrations or turbulences in the discharging stream.

Other features and advantages hereafter appear.

In the accompanying drawings:

Figure 1 is an elevation of the assembled pump showing the relative location of the inlet and discharge ports;

Figure 2 is a horizontal section taken through 2—2 of Figure 1 showing the pump casing, impeller and impeller race;

Figure 3 is a partial vertical section showing details of the impeller and its mounting; and

Figure 4 is a vertical section taken through 4—4 of Figure 2 showing the configuration of the pump casing and the relative location of the impeller race.

Referring to the drawings, a centrifugal pump includes driving means 11 resiliently mounted on a pump casing 12 by an intermediate spider 13. The casing 12 is preferably a casting, and generally U-shaped, see Fig. 2, with inlet and discharge passages 14 and 15 respectively, forming the branches of the U. At the rear of the casing 12, and eccentrically located to be in the zone of the discharge passage 15, there is provided an impeller race 16 adapted to receive a rotary impeller 17 connected by a shaft 18 and suitable flexible coupling 19 to driver 11. Resilient means, such as a spring suspension or the rubber sleeves 20 and washers 20a, see Fig. 3, effect a vibration- and sound-absorbing connection between the motor 11, the spider 13, and the pump-casing bonnet or cover 21. Bolts 22 effect a demountable assembly.

The bonnet or cover 21 may be removably secured to the pump casing 12 by suitable bolts 23 and fluid-tight gasket 24. Shaft 18 is introduced into the casing 12 through a fluid- and pressure-tight gland comprising a threaded packing nut 25 having depending walls 25a enclosing suitable packing material 26. The lower surfaces of the wall 25a bear against packing rings 26a, which may thereby be compressed between a washer 26b and the lower surface of wall 25a, about the shaft 18. I prefer to employ a main shaft bearing 27 of the oilless type, removably housed within a neck 28 depending from, and preferably in-

tegral with, the bonnet 21. Bearing 27 may be lubricated by a wick 27a suitably confined between neck 28 and bearing 27, and fed through channel 32 by grease cup 32a. Shaft 18 may be supported on a stainless steel ball 29 housed within a suitable recess 30 in casing 12, and carried on a bearing block 31, also preferably of stainless steel or other suitable wear- and corrosion-resisting material. Accurately aligned cooperating spherical depressions in block 31 and shaft 18 impart to the ball 29 the combined functions of thrust bearing and shaft alignment means. Unequal wear occasioned by improper shaft alignment or balance of impeller 17 is avoided. A washer 28a may be interposed between bearing 28 and the base of impeller 17.

The pump may rest upon a shock absorbing base, such as the rubber ring 33, keyed into a recess 34 at the base of the pump casing 12. Flanges 35, 36 may be used at the inlet and outlet discharge ports to facilitate piping connections; pipes 35a, 36a are shown in Figure 2.

In Fig. 1 there is illustrated a reaction stop, comprising a tongue 11a, formed preferably as an integral part of the motor housing, and a cooperating rubber-clad bumper 13a carried by the spider to limit the reactionary axial rotation of the entire motor casing with respect to the spider as the pump starts.

The impeller 17, see Figs. 2 and 3, is illustrated as having a plurality of backward-discharge blades 40, carried on a circular base 41, and supporting an annulus 42 preferably dished, as shown. Said annulus provides a central orifice or impeller eye 43. In a preferred embodiment of the invention, five equally spaced blades are utilized.

As indicated in Figs. 2 and 3, the blades 40 are substantially tangential to the circle defining the outer wall of the aforementioned bearing neck 28, although obviously clearly spaced therefrom to permit free rotation of the blades about the stationary neck. The blades may be of full width for approximately one-half of the height, at which point they may be stepped, as shown in Fig. 3, to conform to the width of the annulus 42 and thus form passages or ports 44 directed to the allowance of convection-induced flow of water through the impeller and to the outlet 15 in an inoperative period of the circulator.

The impeller race 16 is defined by an integral wall formed in part by the wall of pump casing—see Fig. 2, in which a portion of the pump-casing wall at the discharge side has been broken away to clear the discharge port 15a of the impeller race—and in part by an upstanding wall 50, see Figs. 2 and 4, which may conform in height to the top of the impeller annulus 42. At the inlet side, the wall may include a tongue or barrier 52, as shown in Fig. 2, which, in cooperation with the surface of the wall 50, the rear of the pump casing and the bonnet 21, defines an inlet port 14a, see Fig. 3.

A circular reservoir 53, see Figs. 3 and 4, effective to quiet turbulences in the inflowing stream is formed above the impeller annulus 42, the said reservoir advantageously having a volume substantially equal to that of the impeller race 16, with which the said reservoir is connected by the impeller eye 43.

It is a feature of the invention that, as clearly shown in Fig. 2, the eccentric location of the impeller race within the pump casing imparts to both the inlet and discharge passages, at the

impeller, a configuration which is of the nature of a volute, and that the relatively constricted inlet 14a moderately increases the velocity of the stream as it enters the reservoir 53 to minimize the sudden change in the velocity of the inflowing stream which is frequently a source of shock in centrifugal pumps.

An additional feature lies in the cooperation of the rear wall of the impeller casing and the tongue 52, see Figs. 2 and 4, to impart an initial rotation to the inflowing liquid stream, causing it to enter the reservoir 53 in a direction substantially tangential to the circle of rotation of the impeller and thus to pass through the eye 43 to be acted upon by the impeller blades without undergoing a sudden change in direction. It is evident also that by imparting such rotation to the inflowing stream, the basic advantage of the backward discharge slope of the blades 40 of the impeller is accentuated, as the blades and stream travel in substantially the same direction and the blades are not caused to slap their way into the stream against a conflicting direction of flow.

Provision is made for the elimination of short circuiting losses, that is, losses occasioned by the escape of liquid from the impeller race 16 to the reservoir 53, at A, Fig. 3, by providing the impeller annulus 42 with an outwardly projecting flange 54, which is arranged to overlie a horizontal shelf 55 formed in the impeller race defining wall, as shown in Fig. 3.

It will thus be seen that features of the invention have been directed to the elimination of hydraulic shocks, which normally in centrifugal pumps are caused by a sudden change in the direction of the flow of liquid, a sudden change in the velocity thereof and/or a sudden reduction in the clear passage area between the inlet port and the impeller. Sudden shocks, occurring in a pump employed in a closed heating system, would engender noise-inducing vibrations which would be a source of annoyance at every portion of the heating system.

Additional details directed primarily to ease of disassembling and servicing the circulator may be found by reference to Figs. 1 and 3. In the latter figure, the impeller 17, which may preferably be formed of casting of brass or the like, is illustrated as being removably attached to the shaft 18, by the screw threaded neck 56 at the base of the said impeller. The entire impeller assembly may be removed by disconnecting the bonnet 21 from the casing and the device made available for inspection or for the replacement of working parts. In Fig. 1, attention is drawn to the configuration of the flanges 35. It will be observed that adjacent surfaces of the said flanges are concave, to permit the distance on centers between inlet and outlet connections to be reduced to less than twice the flange radius. Each flange may thus be turned independently of the other, and without conflict therewith. Such construction makes it possible to employ the flanges in lieu of union joints.

The circulator may be suspended from, or supported by the piping to which it is attached. Preferably, however, provision will be made for independently supporting the circulator, on the annular rubber ring 32, which thereby serves as a vibration dampening base.

Whereas I have described my invention by reference to specific forms thereof, it will be understood that many changes and modifications

may be made without departing from the spirit of the invention.

I claim:

1. A centrifugal pump, including a pump casing having inlet and outlet passages tangentially located with respect thereto, an impeller race eccentrically located within said casing in the zone of the outlet passage thereof, a multi-bladed impeller arranged to be rotated within said race, an annular plate supported by the blades of said impeller, said plate having a central opening communicating with said impeller race, a chamber disposed above said impeller race and divided therefrom by means including said annulus, and passage means associated with said inlet passage arranged to direct inflowing fluid upwardly and to discharge said fluid into said chamber at an increased velocity and in a direction substantially tangential to the direction of rotation of said impeller, said passage means including a wall common to said chamber and to said impeller race and having a discharge orifice of smaller area than the sectional area of said inlet passage, communicating with the said chamber.
2. A centrifugal pump, including a substantially U-shaped pump casing having inlet and outlet passages tangentially located with respect thereto, said inlet and outlet passages arranged in a common plane and having openings defined by a common wall, a horizontally disposed impeller race eccentrically located within said casing in the zone of the outlet passage thereof, a multi-bladed impeller arranged to be rotated within said impeller race, a concave annular plate integral with said impeller blades and defining the upper edges of said blades, said annular plate arranged for rotation substantially entirely within said impeller race and in close proximity to a wall thereof, said annular plate having further, a flange at an upper edge arranged to overlie an upper surface of said impeller race in close proximity thereto, the annular opening of said plate communicating with said impeller race, a chamber having a volume substantially equal to said impeller race disposed above said impeller

race and divided therefrom by means of said annular plate, and passage means associated with said inlet passage arranged to direct in flowing fluid upwardly and to discharge said fluid into said chamber at an increased velocity and in a direction substantially tangential to the direction of rotation of said impeller, said passage means including a wall common to said chamber and to said impeller race and having a discharge orifice of smaller area than the sectional area of said inlet passage, communicating with said chamber.

3. A centrifugal pump, including a substantially U-shaped pump casing having inlet and outlet passages tangentially disposed with respect thereto, said inlet and outlet passages arranged in a common plane and having openings defined by a common wall, a horizontally arranged impeller race eccentrically located within said casing in the zone of the outlet passage thereof, said impeller race being wholly within a space defined by top and bottom surfaces of said inlet and outlet passages and having a base lying substantially in the plane of the lowermost portions of said inlet and outlet passages, a horizontally disposed multi-bladed impeller arranged to be rotated within said race, said impeller including an annular plate supported upon the blades thereof, said plate having a central opening communicating with said impeller race, a chamber having a volume substantially equal to the impeller race disposed above said impeller race, a floor of said chamber being formed by said impeller-supported annulus, and passage means associated with said inlet passage arranged to direct inflowing fluid upwardly and to discharge said fluid into said chamber at an increased velocity and in a direction substantially tangential to the direction of rotation of said impeller, said passage means including a wall common to said chamber and impeller race and having a discharge orifice of smaller area than the sectional area of said inlet passage communicating with said chamber.

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