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METHOD OF CONTROLLING STEAM APPARATUS

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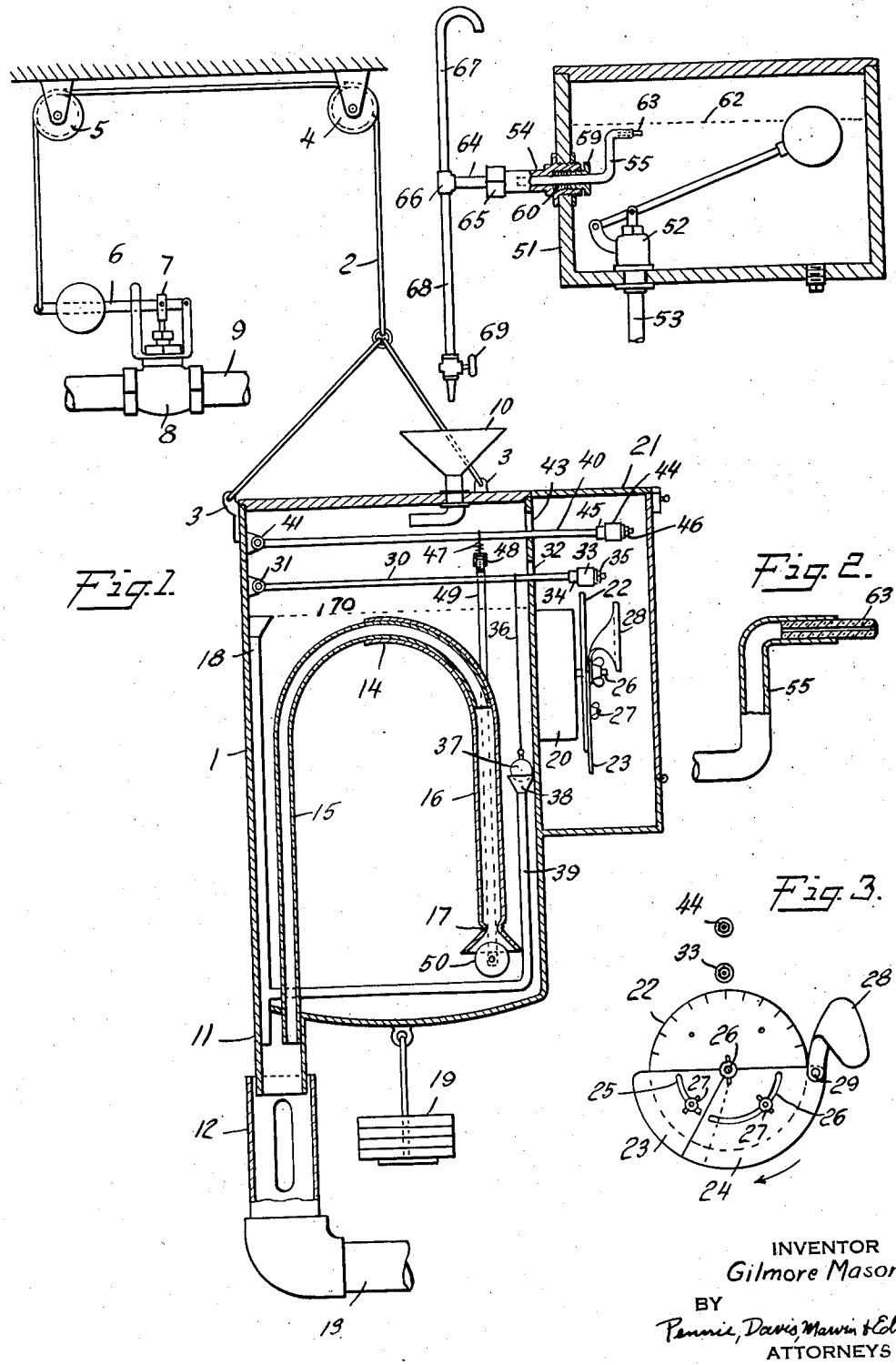


Fig. 1.

Fig. 2.

Fig. 3.

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METHOD OF CONTROLLING STEAM APPARATUS

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This invention relates to valve control and has for an object an improved method of regulating the flow of fluid through pipes. More particularly, the invention relates to the operation of valves and contemplates the provision of an improved method of opening and closing valves at predetermined periods.

According to a method of the invention a steam valve for example, may be opened or closed gradually at predetermined periods. The invention aims to control a steam valve on the main of a central heating system supplying steam to buildings and the like to obtain a cyclic on-and-off operation which is preferably effected by slowly opening and closing the valve during each cycle of operation. This cyclic on-and-off operation may be continued throughout the period when heat is required. In the control of the valve supplying steam to a building, the invention contemplates opening the valve gradually in the morning to enable the escape of water during the admission of the steam and to thereafter maintain it open during a predetermined period to quickly and efficiently initiate the heating of the pipes, radiators, etc. comprising the heating system. A further object of the method of the invention is to provide, in combination with the gradual opening of the valve during the morning, the cyclic operation of gradually opening and closing the valve during the subsequent period when heat is required, for example, during the daytime.

The apparatus for carrying out the method of the invention comprises means for gradually opposing and overcoming the force holding a control valve closed. Such means includes a reservoir tank which is gradually filled with water to open the valve and is gradually emptied of water to close the valve. The rate at which water is uniformly admitted to the reservoir tank determines the rate of opening the valve and the rate of discharging water from the tank determines the rate of closing the valve. This combination of gradually filling and gradually emptying the tank completes one cycle of valve operation.

The apparatus for carrying out the method of the invention contemplates automatic mechanism for maintaining the tank filled during a predetermined period to keep the valve open and for maintaining the tank empty to keep the valve closed.

A further object of the apparatus for carrying out the method of the invention is to provide means for regulating the uniform flow of water into the reservoir tank. A pipe having a fixed orifice is arranged to be submerged variable distances below the surface of a body of water maintained at a desired level. This apparatus accordingly involves the means for imposing a uniform hydrostatic pressure on the orifice with a consequent uniform flow of water therethrough.

This invention will be better understood from a consideration of the accompanying drawing in connection with the following description, in which

Fig. 1 is a schematic diagram of apparatus which may be used in carrying out the invention;

Fig. 2 is a sectional elevation of the orifice of the apparatus; and

Fig. 3 is a side elevation of the automatic control dial of the apparatus.

In the drawing, the reservoir tank 1, which is made of sheet metal, is shown suspended by the flexible cable 2 attached to the triangularly spaced eyes 3. The cable 2 passes over the frictionless pulleys 4 and 5, and is attached to the counter-weighted lever 6 which actuates the stem 7 of the control valve 8. This control valve is preferably of the balanced type and controls the flow of fluid through the pipe 9. The reservoir tank 1 is closed on the top with the exception of a small opening through which a funnel 10 is inserted. This funnel has a curved delivery tube projecting into the reservoir to discharge water along the side of the tank. At the lower portion of the reservoir tank an extension 11 is provided for effecting a positive contact, during up and down motion of the reservoir tank, with a guide pipe 12 connecting with a drainage system 13. A siphon tube 14 is placed within the tank 1 and so arranged that the long leg 15 thereof enters the extension 11 and terminates at a point well below the bottom of tank 1, and the short leg 16 terminates at a point above the bottom of the tank. The lower portion 17 of the leg 16 is flared funnel-like from a section of considerably less diameter than the leg to a section at the mouth of the funnel of greater diameter than the diameter of the leg. The leg 16 is of larger diameter than the leg 15, the latter being inserted into leg 16 to a point below the top of the siphon. This results in an area of restrictive cross-section at the upper part of the siphon. Without this restrictive area there is a tendency for the water to flow through the siphon without starting the siphon action. When it is desired to keep the reservoir tank 1 filled, provision is made for the overflow of water by the drain pipe 18 which discharges into the extension 11. For various reasons it may be necessary to make adjustments in the weight of the reservoir

and this is provided by the adjustable weights 19 attached to the bottom of the tank by means of a rod.

A clock or constant speed motor 20 attached to one side of the tank 1 and within the housing 21 operates a dial 22 which rotates once every 24 hours. This dial is divided into a number of segments to indicate periods of the day. Arcuate cam members 23 and 24 of larger diameter than the dial fit over a shaft 26 in the center of the dial and are concentric therewith. These cams are mounted so that they may be rotatably adjusted with respect to the dial 22 and are provided with slots 25 and 26 through which the lock nuts 27 enter the dial to secure the cams in the desired position. These cams 23 and 24 overlap and accordingly their aggregate peripheral surface may be varied. The cam 28 is fastened to one end portion of the cam 24 by means of a bolt 29.

The lever arm 30 is pivotally mounted on the bracket 31 against one side of the tank 1 and projects through an elongated slot 32 in the opposite side thereof. The free end of the lever has a freely rotatable roller sleeve 33 mounted thereon and held in adjustable position by means of the shoulder 34 and nuts 35. A thin rod or wire 36 is connected to the lever 30 and has at one end a metal ball 37 which fits into a seat in the funnel 38 on the pipe 39. The pipe 39 connects with pipe 18 so that when the valve formed with the ball 37 and funnel 38 is open, water may be discharged into the drain 13.

A lever 40 is pivotally mounted on the bracket 41 attached to the inside surface of the tank 1 and extends through an elongated slot 43 in the opposite side wall thereof. This lever, at its free end, has a rotatable sleeve 44 held in adjustable position by the shoulder 45 and nut 46. A coil spring 47 is attached to the lever 40 at one end and to an adjustable threaded cap 48 at the upper end of a bifurcated member 49 which straddles the leg 16 of the siphon 15 and carries at the lower end thereof a ball 50 adaptable to be inserted into the cone 17 for the purpose of shutting off the flow of water therethrough. The member 49 is accordingly adjustable for length by means of the cap 48.

The rollers 33 and 44 on the levers 30 and 40 respectively are positioned within the housing 21 in a plane embracing the axis of rotation of the dial 22 and directly thereabove. During rotation of the dial the arcuate cam members 23 and 24 contact the roller 35 and raise the lever 30, thus opening the valve formed by the ball 37 resting on the seat of the cone 38. As the rotation continues, a point is finally reached when the arcuate member 24 passes beyond contact with the roller 35, thus dropping the lever and seating the ball 37 in the cone 38. The cam 28 may be so positioned with respect to the cam 24 that approximately at the time when contact is broken between the cam 34 and the roller 35, the cam 28 contacts the roller 44, thus raising the same and carrying with it the lever 40 which raises the ball 50 into the funnel 17, thus closing the same to the passage of water. The length of peripheral surface of the member 28, therefore, determines that portion of the day when the valve 8 is held open because water is not permitted to be removed from the tank 1 by means of the siphon.

The supply tank 51 is positioned above the reservoir tank 1 and has a ball cock 52, of a type well known in the art, connected to a source of water 53 for the purpose of maintaining a constant level of water therein. The coupling member 54 is flanged connected to one side of the tank 51, and has a copper or other non-corrosible metal tube 55 having a double right angle bend inserted into an opening in the center thereof. The inner portion of the coupling 54 is of larger diameter than the tube 55 and is threaded to accommodate the threaded sleeve 59 which fits snugly over the tube 55 and against the packing 60, thus forming a watertight gland in which the tube is free to rotate. The tube 55 projects into the tank 51 and is below the water level 62. The end portion of the tube 55 that is within the water tank 51 has a glass orifice 63 cemented into the end thereof and as the tube is rotated, the orifice is raised or lowered with respect to the surface of the water. The orifice may be made of porcelain glass or other non-corrosive material and is preferably spherically shaped at the end to minimize the accumulation of matter over the opening. A nipple 64 is connected by the union 65 to the coupling 54 at one end, and to a T 66 at the other end into which is connected an open vent 67 and a water delivery pipe 68 having a stop cock 69 on the lower end thereof. The delivery pipe 68 is positioned with respect to the reservoir tank 1 so that when water is discharged out of the cock 69, it falls directly into the funnel 10.

In the operation of the apparatus of the invention the tube 55 is rotated in the coupling 54 to obtain a hydrostatic pressure at the orifice 63 of such amount that a uniform quantity of water, at the desired predetermined rate, will be discharged through the cock 69 into the funnel 10 and then into the reservoir tank 1. By this means a constant stream of water may be discharged into the tank 1.

We shall assume that the reservoir tank 1 is empty, the valve 8 closed and the rollers 35 and 44 out of contact with the cam members 23, 24 and 28, the ball 37 resting upon the seat of the funnel 38 thus preventing the flow of water through the pipe 39 and that the ball 50 is suspended below the funnel 17 leaving the same open. The weights 19 are adjusted to set the time in each cycle when the valve is closed and open. For example, in a cycle of one hour the weights may be adjusted so that the valve will be closed or closing for forty-five minutes and open or opening for fifteen minutes, or, open or opening for thirty minutes and closed or closing for thirty minutes. With this arrangement of the various parts of the apparatus, the water commences to rise in the reservoir tank 1 and when the weight thereof exceeds the force holding lever 6 down the tank commences to fall and open the valve 8. When the water reaches a point just above the top of the siphon, it begins to discharge water through the leg 15 into the drainage system 13. By reason of the relatively smaller diameter of the pipe 15 than the pipe 16, there is a positive siphon action started whenever the head of water in the tank 1 rises above the top of the siphon 14. The water is discharged from the siphon at a greater rate than it is admitted to the tank 1 and accordingly it begins to rise at a rate determined by the difference between the quantities of water discharged and admitted. As the water continues to discharge a point is reached where the weight of tank 1 is less than the force tending to hold lever 6 down and the tank rises closing valve 8. It will thus be seen that when the valve 8 begins

to close it does so at a rate proportional to the rate of rise of the reservoir tank. The weight **19** determines how long the tank **1** remains at the top or at the bottom before the fall or rise, as the case may be, commences.

When the water reaches the bottom of the conical portion **17** of the tube **16**, the siphon action is broken and the discharge of water from the reservoir tank is stopped. By reason of the great difference in area between the edge of the conical end **17** and the restricted orifice where it joins the leg **16**, a positive interruption in the flow of water through the siphon is effected when the water in the reservoir tank falls to the level of the lower edge of leg **16**. A suction action takes place and this results in a positive clearance between the end of the siphon and the water. At this stage of the operation the tank **1** has passed upwardly to its maximum height, i. e. to a point which is sufficient to completely close the control valve **8**.

After the discharge of water from the reservoir tank **1** stops, it commences to fill immediately for the reason that the water is constantly flowing therein from the supply tank **51**. As the water commences to rise in the reservoir tank **1**, a point is reached when it commences to move downwardly, thus raising the lever **6** and opening the valve **8** again. This completes a cycle of control valve operation.

When it is desired to interrupt the operation of the control valve, as for example, during the nighttime, the cams **23** and **24** on the dial **22** are set so that at any predetermined time, for example, 6 p. m., contact is made with the roller **33**, thus raising the ball **37** permitting discharge of water through the pipe **39**. This prevents the tank from filling and keeps the control valve closed. The cam **23** is set with its advancing edge set on a particular time mark on the disc **22** and this determines the time when the contact is made with the roller **33**. As has been explained, the aggregate peripheral surface of contact of the cams **23** and **24** may be varied to contact the roller **33** for periods of different duration. Accordingly, the peripheral surface of the cams may be so arranged that they will be in contact with the roller **33** for any predetermined number of hours, as, for example, from 6 p. m. to 6 a. m. When the predetermined time for opening the control valve has arrived, the cam **24** rotates beyond contact with the roller **33**, thus lowering the lever **30**, and the ball **37** seats in the cone **38**, thus shutting off the discharge of water from the reservoir tank. The reservoir tank commences to fill and move downwardly, thus opening the control valve, and this action continues until the valve is wide open, after which the siphon action starts. At this point two variations in the automatic operation of the valve may be made; first, the siphon action may be permitted to take place as hereinbefore described, in which event the tank is emptied and the regular cycle of operation of opening and closing the valve is commenced and continued, and second, discharge of water from the reservoir tank by means of the siphon action may be interrupted by arranging the cam **28** to contact with the roller **44** and close the entrance to the siphon by raising the ball **50** into contact with the flared end **17** of the siphon. The tank **1**, therefore, fills to the level **70** and overflows into the drain pipe **18**. With this arrangement of the apparatus the tank **1** is positioned to hold valve **8** open. This will permit discharge of steam through the pipe **9** to the full capacity thereof for a period determined by the time of contact of the cam **28** with the roller **44**.

The valve control apparatus and method of the invention may be adapted to valves used on any fluid system, for example, steam, water or gas, but are particularly adaptable to the control of steam supplied by a central generating plant. It is extremely desirable to admit steam gradually to a cold system, as when it is first turned on in the morning, because there is a rapid condensation of steam and formation of water, and if steam is admitted too rapidly there is apt to be a pipe hammer set up. Accordingly, the invention overcomes the disadvantages resulting from the sudden admission of steam into a cold heating system by gradually opening the valve during a predetermined period.

It is a well known fact that economies in the operation of a steam heating system may be effected by interrupting the flow of steam thereto at regular intervals during the daytime or other period when heat is desired and the invention, accordingly, provides an improved and positive means of achieving this end.

Throughout this specification reference has been made to the opening and closing of the control valve by the upward and downward motion of the reservoir tank. The invention is not limited to an operation of closing the valve when the reservoir tank rises or opening the valve when the tank falls. Quite obviously, these operations may be reversed and are to be considered as equivalents for the purposes of the invention. Moreover, various means of transmitting the vertical reciprocable motion of the reservoir tank to the valve steam may be effected and the invention is not to be limited to the specific suspension means illustrated.

I claim:

1. The method of automatically operating a steam valve controlling the supply of steam from a generating system to a building heating system which comprises slowly opening the valve to initiate the admission of steam to the heating system at the beginning of a period when heat is required in the building, maintaining the valve open independently of conditions in the space to be heated for a sufficient period to heat the heating system to the required extent, thereafter effecting a cyclic on-and-off operation of slowly closing and slowly opening the valve during the remaining period when heat is required, and then slowly closing the valve and maintaining it closed during a period when heat is not required in the building heating system.

2. In the method of claim 1, effecting the cyclic on-and-off operation of the valve by slowly accumulating and discharging a volume of water, the weight of the accumulated water effecting the operation of the valve in one direction and the discharge of the water effecting the operation of the valve in the other direction.

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