Automatic Mechanical Urinal Flusher

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***Abstract*- In today's life, most people fail to flush the urinal system after using it. It creates bad odour and unpleasant environment especially in public restrooms, which affects the health of the people using it. And typically in some cases, people fail to close the faucet (tap) properly after using it, which leads to the wastage of water. This causes various problems to the environment. Water is an important resource, which we owe the responsibility to pass to the future generations. The wastage of excess water as well as the unpleasant conditions in the surrounding is the threat to the environment.**

To overcome these problems, it is proposed to design an automatic urinal flushing system by using the reciprocating mechanism of the links and levers, which flushes the urinal system automatically after usage. Only limited amount of water is used to flush after every usage so that wastage of water would be stopped. It is very economic and provides a good and clean hygienic environment for the public. It does not require electrical power for operation and can be utilized in large scale in rural areas with minimum capital cost and maintenance.

***Index Terms*- Urinal, Flushing, Save water**

1. INTRODUCTION

Whether rich or the poor, tribe or countrymen, Indian or American, be it any living organism, the very common thing that everyone does daily, is the intake of food and water, along with the excretion of waste through various forms. In public restrooms, due to the improper flushing of the toilet and maintenance, bad odour and unpleasant environment are common to be found in most public restrooms. This unhygienic environment creates discomfort to the users along with diseases such as Nausea, Asthma, etc. On the other hands, people who use the urinals at the public restrooms, fail to close the faucet (tap) after using it, as they feel uncomfortable to touch the Unhygienic parts of the urinal. This leads to the wastage of the water continuously for hours until another person who willingly closes it and in most cases the water is continuously made to flow non-stopped. Due to this large amount of water has been wasted. To overcome this problem, the automatic urinal flushing system with the sensors and micro-controllers has been in use in many public places. However, this electronic urinal flushing system is comparatively expensive and requires electrical power for operation. In addition, it is in use only in places such as hi-fi hotels, malls, restaurants, etc. and it's quite unsuitable for implementation in public restrooms such as in bus depots, railway stations, etc. Thus it is proposed to device an automatic urinal flushing system based on mechanical linkage mechanism, which do not require electrical power and also suitable for usage in any kind of public places. This ensures proper flushing of toilet by minimizing the water usage by causing only limited amount of water to get flushed after every usage, automatically. Most of the present day toilets and urinal flush devices for sanitary facilities are operated by a water control valve which includes a manually operable flush handle adapted to be gripped and moved by a user. However, those manually operated valve actuation devices have many problems for e.g. use of such manually operated flush can lead to diseases thus users avoid to touch / use the flush button. Therefore, the sanitary facility may remain un-flushed which increases the unsanitary conditions, and fouling the atmosphere in the facility. Also, a large volume of water is wasted every time a user flushes a standard toilet.

Thus there is a great need for a low cost automatic flushing apparatus which can flush the essential-controlled amount of water and avoid direct hand contact, thus conserving water as well as maintaining personal hygiene and sanitation. The present invention discloses an automatic flusher with dual-valve pipe mechanism actuated by a mechanical platform.

2. OBJECTIVES

The main objectives of this project are as follows:

1) To provide a clean and hygienic environment near, Urinals at the public restrooms by making it to get flushed automatically, using mechanical linkages.
2) To use the less and limited amount of water for Flushing purpose.
3) To prevent the unnecessary wastage of water and save the water resource for our future generation.
4) To avoid the external power source for urinal flushing.
5) To provide a cheapest urinal flushing.
6) To provide less maintenance of the flusher.
7) Less costly so anybody can buy easily.
8) To prevent the condition of bad odour resulting in various diseases due to unhygienic environment.

3. METHODOLOGY

The automatic flushing of the urinal is proposed with the action of kinematic mechanical link with the actuation and deactivation of the ball valve, with the help of spring. The fabrication has been done by welding process.

4. DESIGN OF AMUF

The automatic urinal flushing system proposed in this paper is made by the following list of components:

A. Primary tank & storage tank (flushing tank)
B.¾" ball valve
C.1" ball valve
D. Urinal & Pedestal
E. Base
F. Lever and linkages
G. Spring

A. Primary Tank & storage tank

The primary tank is the reservoir for water storage. It is the general water storage tank at our roof top, which would be the source for all our plumbing connections within the building.

The storage tank or the flushing tank is the secondary reservoir at the urinal, which stores the amount of water temporarily, which is to be flushed at the urinal, after its usage.

B. ¾" Ball Valve

The ¾" ball valve is the flow control valve, used to control the flow of water from the primary tank to the flushing tank. This ball valve is kept at normally open condition and would be closed during the usage of the urinal by the person.

C. 1" Ball Valve

The 1" ball valve is another flow control valve, used to control the flow of water from the flushing tank to the urinal. This ball valve is kept at normally closed condition and would be opened during the usage of the urinal by the person.

D. Urinal & Pedestal

The urinal is the basin in which the person would be urinating into. The urinal is connected to the water exhaust pipe.

The pedestal is the stand or place where the people who need to pass the urine have to get into and urinate. It would be connected with the lever such that the pedestal would be pressed slightly downwards to certain inclined angle, so as to operate the ball valves.

E. Base

The base is the rigid part which bears the entire urinal flushing system. The pedestal would be mounted over the base.

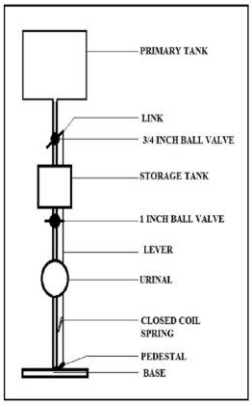
F. Lever and linkages

The lever would be connected to the pedestal and the ball valves such that when the person gets into the urinal, the pedestal gets pressed downwards so as to control the ball valves. The linkages are made by welding process.

G. Spring

The closed coil spring would be provided to connect the pedestal such that during the removal of load from the pedestal, the pedestal returns to its original position.

5.2D FRAME MODEL



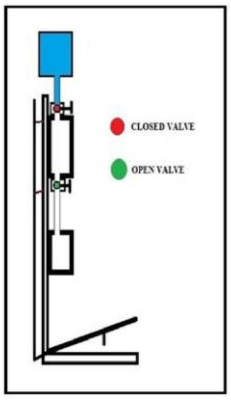


Fig. 1 Front view of the Automatic urinal flushing system AND Fig. 2 Initial stage of operation

6. WORKPLAN

The working process of the automatic urinal flushing system can be easily explained in three stages:

a. First stage
b. Second stage
c. Third stage

a. First stage:

At the initial stage of the operation, the urinal would be at its rest position. The pedestal would be at its normal position. The ¾ inch ball valve at the top would be in closed condition and the 1 inch ball valve at the bottom would be in open condition.

Here, water from the primary tank cannot enter the secondary storage tank. The closed coil spring remain in its normal closed condition during this stage of operation of the automatic urinal flushing system.

Highlights:

- ¾ inch ball valve – closed condition
- 1 inch ball valve – open condition

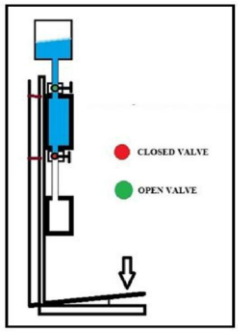
b. Second stage:

During the secondary stage of operation, the person who needs to pass the urine, gets into the urinal, i.e. he stands into the pedestal of the urinal flushing system. Due to the application of load into the pedestal, the lever gets pressed downward and the pedestal gets inclined download.

This causes the upward movement of the linkage causing the closure of the 1 inch ball valve and the opening of the ¾ inch ball valve. Thus, the water from the primary tank gets into the secondary and temporary storage tank through the ¾ inch ball valve. Water gets filled in the secondary tank until the person urinates in the urinal. The water do not get flushed into the urinal from the secondary tank as the 1 inch ball valve would be closed. The spring remains expanded during this stage of operation.

Highlights:

- ¾ inch ball valve – open condition
- 1 inch ball valve – closed condition



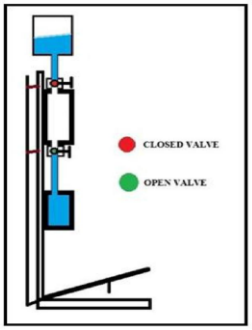


Fig. 3 Secondary stage of operation
Fig. 4 Final stage of operation

c. Final stage:

During the final stage of the operation, the person gets down from the pedestal after urinating. Due to contraction of the closed coil spring, the pedestal returns to its initial original position so that the level gets returned to its initial position. During this action of the lever, the ¾ inch ball valve gets closed and the 1 inch ball valve gets opened.

This would cause the flushing of the urinal by the water from the secondary storage tank through the 1 inch ball valve. The water supply to the secondary storage tank from the primary tank would be stopped as the ¾ inch ball valve gets closed.

Highlights:

- ¾ inch ball valve – closed condition
- 1 inch ball valve – open condition

Thus, water gets flushed into the urinal after the usage of the urinal automatically. Water do not get wasted continuously in this urinal. Even when the person stands in the urinal for a much longer time, water does not get flushed continuously. Only limited amount of water would be flushed into the urinal, irrespective of the time that the person takes to urinate, into the urinal. Only minimum amount of water would be capable in the secondary tank and only that volume of water would be made to flush into the urinal, always irrespective of the time that the person takes for urinating. Thus, water wastage would be greatly prevented in this system.

The entire operation is made automatically through kinematic mechanism without any need for external electrical power. In order to prevent the unpleasant odour, naphthalene balls can be put inside the

secondary storage tank so that the unpleasant odour would be prevented right at the source itself. Thus, this system greatly reduces wastage of water, with lesser money and with additional advantages.

7. ACTUAL IMAGE

Fig. 5 Image in 3D

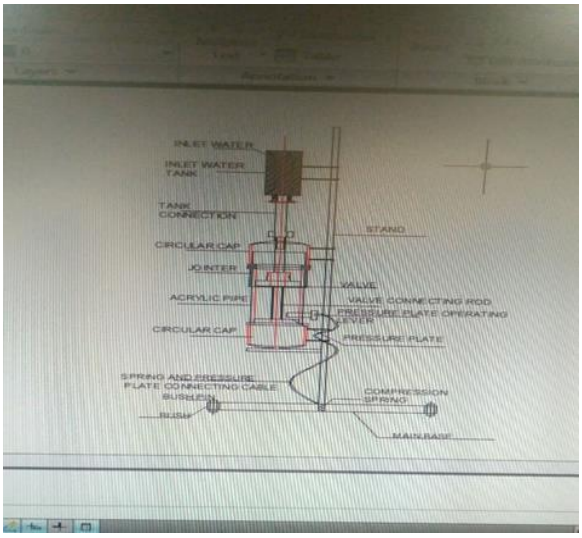


Fig. 6 In AutoCAD Design

8. CALCULATIONS

DESIGN OF SHAFT:

TORQUE CALCULATIONS

Considering the dia. Of shaft = 20 mm

$T = \Pi/16 X Fs X d^3$

$= 0.196 X 162 X (20)^3$

$= 254336 \ N/mm^2$

$$\text{Power (P)} = \frac{2\pi NT}{60}$$

$$P = \frac{2\Pi X 500 X 254336}{60}$$

$= 2662050.133$ watt

Considering 25% over load

Tdesign = 1.25 x254336

Tdesign = 317920 N-mm

I) DESIGN OF SHAFT.

MATERIAL SELECTION: -

Ref: - PSG (1.10 & 1.12) + (1.17)

ASME CODE FOR DESIGN OF SHAFT

Since the loads on most shafts in connected machinery are not constant, it is necessary to make proper allowance for the harmful effects of load fluctuations

According to ASME code permissible values of shear stress may be calculated form various relation.

$fs_{max} = 0.18$ fult

$= 0.18 \times 900$

$= 162 \ N/mm^2$

OR

$fs_{max} = 0.3$ fyt

$= 0.3 \times 700$

$= 210 \ N/mm^2$

Considering minimum of the above values;

$\Rightarrow fs_{max} = 162 \ N/mm^2$

Shaft is provided with key way; this will reduce its strength .Hence reducing above value of allowable stress by 25%

$\Rightarrow fs_{max} = 121.5 \ N/mm^2$

This is the allowable value of shear stress that can be induced in the shaft material for safe operation

TO CALCULATE INPUT TORQUE

DESIGNATION	ULTIMATE TENSILE STRENGTH N/mm2	YEILD STRENGTH N/mm2
EN 36C	900	700

$$\text{POWER} = \frac{2\Pi NT}{60}$$

Wire Diameter mm	Outer Diameter Mm	Stiffness Of spring Per turn K1 N/mm	Permissible load	
			Static Load N	Dynamic Load N
3.0	12.0	7.98	32.4	14.5

$$\Rightarrow T = \frac{60 \times P}{2 \times \Pi \times N}$$

$$= \frac{60 X 2662050.133}{2 X \Pi X N}$$

Assuming operation speed = 500 rpm.

$$= \frac{60 \times 2662050.133}{2 \times \Pi \times 100}$$

$\Rightarrow$ T = 254336 N.m

Assuming 25% overload.

$\Rightarrow$ T design = 1.25 x T
= 1.25 x 254335
= 317918.75N.mm.

- CHECK FOR TORSIONAL SHEAR FAILURE OF SHAFT.

Assuming minimum section diameter on input shaft = 20 mm

$\Rightarrow$ d = 20 mm

$Td = \Pi/16 \times fs_{act} \times d^3$

$$\Rightarrow fs_{act} = \frac{20 \times Td}{\Pi \times d^3}$$

$$= \frac{20 \times 317918.75}{\Pi \times (20)^3}$$

$\Rightarrow fs_{act} = 253.120\ N/mm^2$

As $fs_{act} < fs_{all}$

$\Rightarrow$ I/P shaft is safe under torsional load

DESIGN OF SPRING:

A) STIFFNESS OF SPRING (Ks) :

$$Ks = \frac{K1}{n}$$

Where K1 = Stiffness of spring per turn K1 (N/mm)
n = Number of turns of spring = 6

Ref. PSG DESIGN DATA HANDBOOK

Stiffness and permissible static and dynamic loads for helical compression springs

Wire Diameter mm	Outer Diameter Mm	Stiffness Of spring Per turn K1 N/mm	Permissible load	
			Static Load N	Dynamic Load N
3.0	12.0	7.98	32.4	14.5

$$Ks = \frac{K1}{n}$$

$$Ks = \frac{7.98}{6}$$

Ks = 1.33 N/mm

B) COMPRESSION OF SPRING TO EXERT A FORCE ' F' ($\delta 1$)

$$\delta 1 = \frac{F}{Ks}$$

$$= \frac{4.242}{1.33}$$

$\delta 1$ = 3.18947 mm

9. ADVANTAGES

The main advantages of this automatic urinal flushing system include:

1. Wastage of water in the urinal would be greatly prevented.
2. Prevailing of bad odour and unhygienic environment in public restrooms such as those in bus stands, railway stations, etc. would be prevented.
3. This type of automatic urinal flushing system do not require external power source.
4. This system is comparatively less expensive than the electronic urinal flushing system.
5. The naphthalene balls could be put inside the secondary tank itself, so that the bad odour due to the urine would be neutralized, right at the beginning stage itself.

10. APPLICATIONS

This type of automatic urinal flushing system could be used in places such as

1. Public restrooms
2. Bus stands
3. Railway stations
4. Parks
5. Government offices.
6. Public gardens, etc.

11. CONCLUSION

Water is the universal resource and every living being has the right to access clean and hygienic water. It is our responsibility to pass this natural resource to the future generations. Measures have to be taken by everyone to save water by all possible means. This type of urinal flushing System

could be incorporated in public places to provide clean, hygienic and Comfortable use of restrooms, in addition to saving of water resource.

"A DROP OF WATER IS WORTH MORE THAN A SACK OF GOLD TO A THIRSTY MAN"

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