International Journal of Mechanical Engineering and Robotics Research

ISSN 2278 – 0149 www.ijmerr.com
Vol. 2, No. 4, October 2013

Research Paper

WORKING OF NEW DESIGN OF DOOR CLOSER

R W Dakhole[1]*, R D Askhedkar[1] and S K Choudhary[1]

*Corresponding Author: R W Dakhole, ✉ rashmi_nagpure@yahoo.com

A door closer is a mechanical device that closes a door, which is open by push or pull action manually or automatic.The closer available in a market can involve the consideration of a variety of criteria. In addition to the closer's performance in fire situations, other criteria are resistance to opening forces (for use by disabled or infirm), control over the rate of closing, safety, durability, risk of vandalism, and aesthetics. This paper gives the detail concept and mechanism for the new design of door closer which is tested on fabricating model. The design using various components like compressive sprial spring and simple gear train arrangement. To test the mechanisum working a small model fabricated. The images give the brief idea how the actual design look and performance tested by appling force.

Keywords: Spiraltorsion spring, Spur gear, Links, Bracket

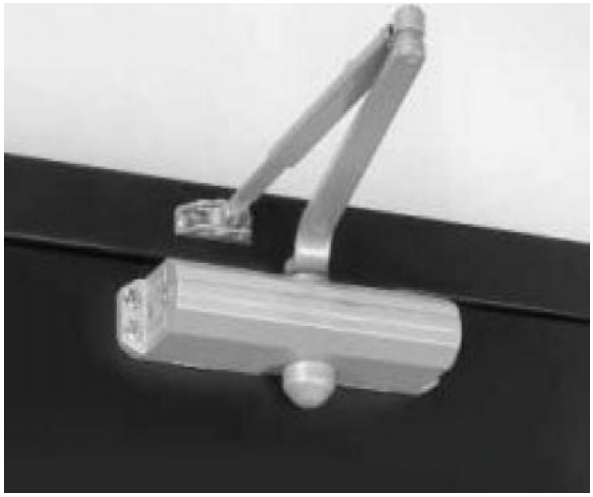
INTRODUCTION

Now in a modern day's door closer is a basic need of door. To close the door in offices, schools, hospitals and in houses for fire safety and maintaining room temperature. The approach for development of product like door closer was that, the door closer available in market was all run on hydraulic cylinder.

Hydraulic cylinder have main disadvantage as that oil leakage, if the oil leakage start from the system then whole system must be replace. The replacement of single unit cannot take place. The aim of the project was to construct and design a door closer which work on gear system that has practically needs minimum maintenance, was simple in erection and fulfilled the required specifications. Main objective is that to optimize the cost of product by run the product for long time. The selected design was then studied thoroughly and elaborated. After elaborating the design, dimensioning and calculations we redesign and the final design was fabricated with exact selection of materials and parts. The model was tested and checked thoroughly for its working. All aspects were kept in view,all possible improvements and modifications done in a new design which resulted in a better performance of thedoor closer.

[1] Department of Mechanical Engg., KDKCE, Nagpur, India.

Figure 1: Overhead Door Closer



Problem Identification

Door closer with hydraulic system mostly used overhead hydraulic system:It accomplishes this by using spring tension modulated by hydraulic fluid. As the user opens the door, hydraulic fluid passes from one reservoir to another, and as the spring pushes the door closed again, the hydraulic fluid passes back to the previous reservoir through a series of valves that control the speed.

The following problems are identified in the existing overhead hydraulic system.

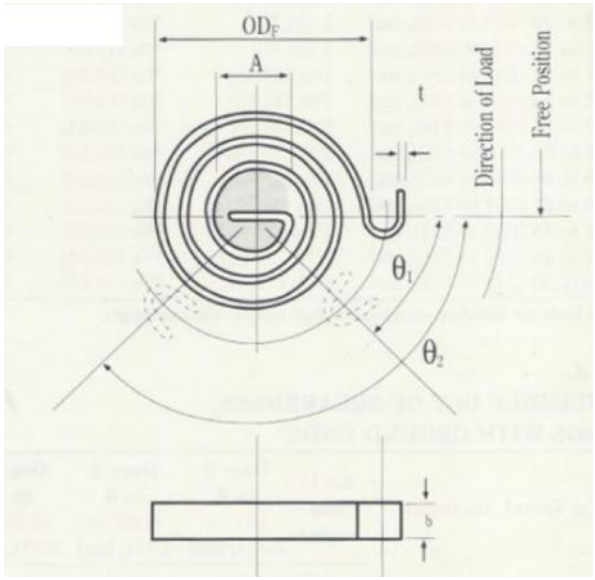
- If oil is leaking from your door closer, throw it away and buy a new one.
- If your door closer is slamming the door and cannot be adjusted to do otherwise, either the fluid has leaked out or the valve seals are worn out. Either way, your best option is to replace it.
- If the door closer has no spring tension and the spring tension adjustment turns round and round with no effect, the spring is broken the door closer must be replaced.

MATERIALS

Compressive Spiral Spring

So the strong steel spring can be used to close the door automatically. Here same thing can be achieved by using Compressive spiral spring intead of helical compressive spring (Handbook of Spring Design, 2002; and Lakshmankumar, 1987).

Figure 2: Compressive Spiral Spring



A spring is an elastic object used to store mechanical energy. Springs are usually made out of spring steel.

High Carbon Steel (AISI 1095-ASTM A 682 Sheet and Strip Properties).

AISI 1095 delivers the best fatigue values and elasticity of any of the high carbon spring steels. This makes AISI 1095 an excellent choice when your flat spring, clip or sheet metal stamping design must be pushed to its limits.

Nominal Chemical and Physical AISI 1095:

C 0.90-1.04%

Mn 0.30-0.80%

Minimum Tensile Strength psi x 10^3 180-340

E - Modulus of Elasticity psi x psi x $10^6$30 Maximum Operating

Temperature 250 °F Rockwell Hardness C40-52

Heat Treating AISI 1095

AISI 1095 is delivered in annealed (soft) condition where, after fabrication, is quenched and tempered to a spring tempered condition. The second condition is called Blue Polished, where the material is already processed to a pre-tempered condition. After fabrication, the pre-tempered material usually undergoes a stress relieving process.

Manufacturing

AISI 1095 is cold drawn and heated to either annealed condition or to a high and uniform tensile.

Uses

High quality flat springs, clips and sheet metal stampings.

Small springs can be wound from pre-hardened stock, while larger ones are made from annealed steel and hardened after fabrication. Some non-ferrous metals are also used including phosphor bronze and titanium for parts requiring corrosion resistance and beryllium copper for springs carrying electrical current (because of its low electrical resistance).

When a spring is compressed or stretched, the force exerts is proportional to its change in length. The rate or Spring constant of a spring is the change in the force it exerts, divided by the change in deflection of the spring. That is, it is the gradient of the force versus deflection curve.

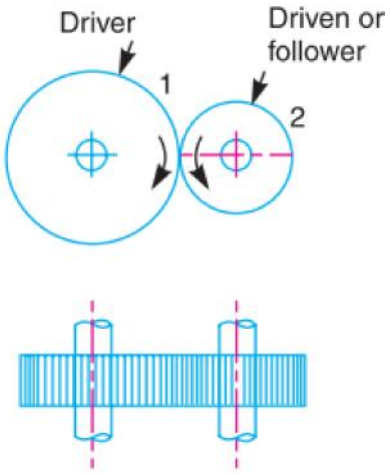
Figure 3: Compressive Spiral Spring

Simple Gear Train Arrangement

When there is only one gear on each shaft, it is known as simple gear train. The gears are represented by their pitch circles.When the distance between the two shafts is small, the two gears 1 and 2 are made to mesh with each other to transmit motion from one shaft to the other, Since the gear 1 drives the gear 2, therefore gear 1 is called the driver and the gear 2 is called the driven or follower. It may be noted that the motion of the driven gear is opposite to the motion of driving gear (Khurmi and Gupta, 2006).

Gear used in this model is of mild steel material.

Figure 4: Simple Gear Train Arrangement



Links and Bracket

To gear connecting link-1 is fixed and to that connecting link-2. At bracket hinge connecting link-2 connected provide rotation motion which is paraell to door.Connecting link-1, connecting link-2 and hinge point of bracket in horizontal line and parallel to door panel. Bracket connected to the door frame by nut and bolt

S.S. plates are used to fabricate the links.

M.S./S.S material is used for bracket also.

Other Components

Shaft

Shaft is used to transmit the motion from drive gear to driven gear, as the drive gear and driven gear name changes of the gear in mechanisum as per the open and close mechanisum. The load applied on them and stresses develop in the mechanisum is so small that any material M.S./S.S rod can be used.

Bearing

The main purpose of bearing is to transmit the free rotation from shaft to gear.

So any type of bearing can be used, i.e., roller type or bush also used .

CONSTRUCTION OF A NEW DESIGN

Fabricated Model

Fabricated model is represent the door closer. Which is performing operation when door is in open position. The components used in model are door of 1.5 feet * 3 feet on which pull and push operation is being perform by using small gears and compressive sprial spring. To visualise the operation of mechanisum acrelic material used for the door.

Figure 5: Door in Closed Position

Figure 6: Door in Open Position by Appling Pull Action

Figure 7a: Enlarged View When Door in Close Position

Figure 7b: Enlarged View of Door Closer in Close Position

Two link used in the model in which one is of MS and other is of acrelic material by considering the model size. The complete unit fix in box which is fixed to the door.

The operation or performance of door closer tested by this model.With the help of this model we actually see the performance of the door closer.

By testing,and considering all the aspect of the model now we proceed to fabricate the actual size model.

By cosidering the actual design calculation model has been developed in software.

On that model actual performance tested and design compatibility has been check.

Construction

Spiral Spring is fixed at bottom by 10 mm offset distance of driven gear (Pinion) is allowed to rotates in bearing fixed on the base plate. Driven gear meshed with driver gear and driver gear also fixed in the bearing with the help of shaft.

Then complete gear train arrangement fixed on the base plate which fixed on the back side

Figure 8: The View that is Door in Closed Position

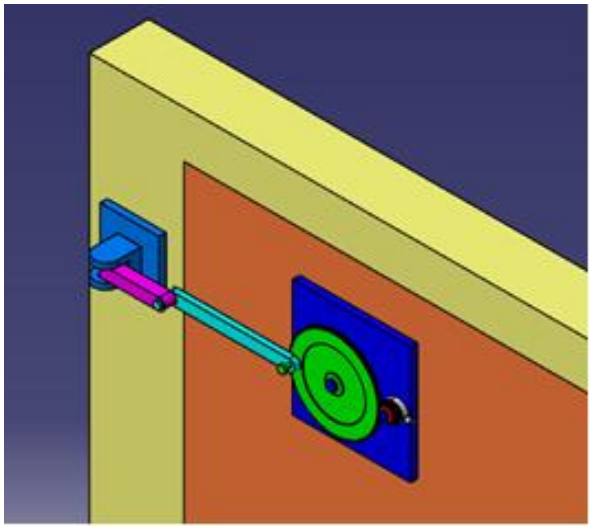
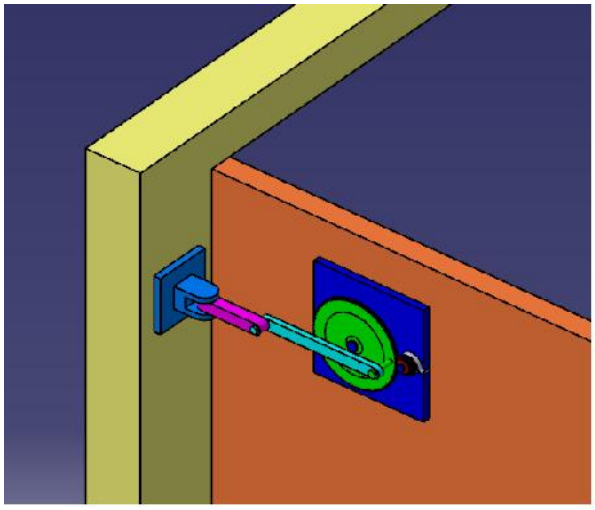


Figure 9: Door in Open Position



of door from top of the door 50 mm lower. Connecting link-1 is fixed to the gear. Connecting link-2 get connected to connecting link-1 on other side connect with bracket. Bracket is fixed to the door frame on the door hinge side.

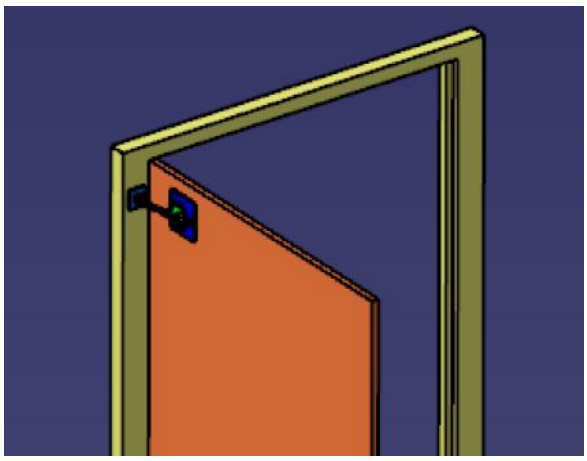
PRINCIPLE OF DOOR CLOSER

As we assume the door gets open manually by push or pull action only 90º for calculation.

The connecting link-1and connecting link-2 get rotate parallel to door by 90º. Which rotate the gear. The shaft connected to the gear which complete the half rotation of driver gear and proportionate rotatation of pinion gear.

Here the gear ratio of 3 is maintain. Due to pinion gear rotation compression of spring take place which store energy. That energy is used to close the door automatically. The force generated by the compressed spring provides precise control in the door closing cycle, i.e., closing force and energy stored in them is called closing moment. Closing moment is different for different sizes of door, i.e., depend upon the door width and door weight.

Figure 10: Door in Open Position



WORKING OF DOOR CLOSER

Each door closer having different spring assembly provides a closing force on which a Door Closer Works.

The basic function of a door closer is to provide a smooth, controlled closing action to the door after the door has been opened and released. A modern compression spiral spring with gear arrangement provides the function in the following manner.

As the door is opened, by pulling or pushing action according to A.D.A. standard (Edward and Scott, 1993; and Norton, 2012) the link moves as the door open .Link transmit the motion to gear train assembly ,in which drive gear rotate the pinion gear in a proportionate ratio. This compresses the spring which provide the energy necessary to close the door.

In the door opening cycle, the gear teeth of the driver rotate the pinion/shaft. The compressed spring get compressed. The gear ratio and spring tension controlling the door closing speed.

During the closing cycle the applied force released, the compressed spring start releasing and the reverse or back action start. The compressed spring rotate the pinion gear and driver gear in reverse direction. Due to closing force of the spring the door get automatically close.

RESULTS

By using this new design we tried to develop the new mechanisum which is simple in construction, parts available in a market, replacement of single part done and that's why it is long life product. By fabricating model the testing of mechanisum is done.

CONCLUSION

The present study is centered toward the design of a door closer that would conveniently alleviate the problem of oil leakage which effect the life of the product. This is inovative design. To verify the mechanism provide to the arrangment working model has been fabricated which run successfully. The analysis of the arrangement done but that is not given

in this paper. Some modification also required in this arrangement by which the force required for latching we get.

REFERENCES

1. Dakhole R W, Askhedkar R D and Choudhary S K (2013), *IJERT*, Vol. 2, No. 7, ESRSA Publication Pvt. Ltd., ISSN-2278-0181.
2. Dietrich Jentsch (1980), "Automatic Door Closer Constructed for Releasably Holding a Door in a Predetermined Partly Open Position", Pattern 4324996 (US Pattern) 1, November.
3. Edward Steinfeld and Scott Danford G (1993), "Automated Door: Towards Universal Design", The Center for Inclusive Design and Environmental Access School of Architecture and Planning Suny/Buffalo, October 25.
4. *Handbook of Spring Design* (2002), SMI Publication.
5. Jimmy D Lee (2010), "Gate Closers—What to Know Before You Buy", Article Source: http://EzineArticle.com
6. Khurmi R S and Gupta J K (2006), "Theory of Machine", ISBN 81-219-0132-4 Published by Eurasia Publishing House (P) Ltd.
7. Lakshmankumar (1987), "Engineering Guide to Spring Design", Associated Spring Barnes Group Inc.
8. Lynette Holroyd (2011), "Door Closers—The Different Types and Their Role in Fire Safety", Article Source: http://EzineArticle.com
9. Michal Panish (2012), "Manual Door Closers—Do You have an Open and Shut Case", May 06.
10. Norton – Assa Ablox (2012), "Door Closer General Information", September 28, www.nortondoorcontrols.com