Evaluation of Design and Simulation of Gas Spring Testing of Old and New Grooving Machine and Load, Experimental

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Abstract - *This paper aimed at design of new grooving machine as well as reduced rejection part's, cost. Analysis and observation working process Tube grooving machine. The tube bending has become one of the most problem in this section. Observation part of grooving tool and tube fixture not working properly and analysis part develop a 3D model in catia 5v and ansys for to check exact where tube is bend and who to working testing tube . And most important part of this paper is reduced rejection parts, cost and comparison of cost and part before/after.*

Key Words: gas spring, testing tube, Grooving tube, new fixture, Catia 5V and ansys

1.INTRODUCTION (Gas Spring)

Gas springs is defined as hydro-pneumatic, energy storage elements. Nitrogen gas and oil are utilized for providing compressible and damping mediums. Gas springs are configured to meet a wide range of requirements

$$F = \frac{\Delta P}{A}$$

force (F) is equal to the pressure differential (P) between internal and external (environment) pressures, acting on the cross-sectional area of the rod (A).Gas spring is a type of spring.

Gas springs are used for implemented in two different gas spring works. The first one is the *pneumatic gas spring*, where the spring is implemented by an air chamber surrounding the tube. And second is hydro-pneumatic gas spring where an accumulator is linked to the shock absorber and the gas included is compressed by the movements of the fluid.

Fig.: 1 gas spring

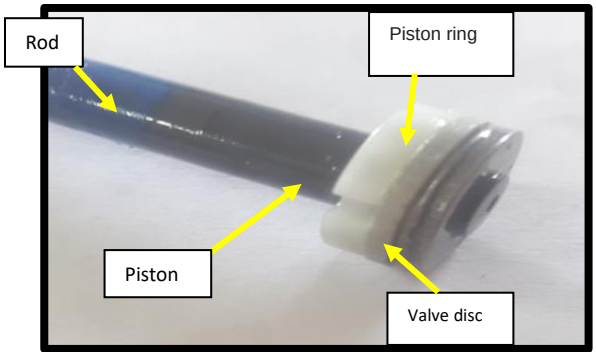


Fig.: 1.2 Rod assembly

1.1 Gas spring working process: -

The gas by pushing by piston rod into the tube, which is released when the piston slides out. Just like a basic mechanical spring, gas springs don't have any innate motion control ability. As the piston rod is introduced into the compression stroke, the internal gas volume decreases resulting in a proportional increase in pressure (Boyle's Law), the force of a gas spring is higher when the rod is compressed. As well as some compressed gas bypass "V" shape of nozzle for come back to original option. As show in fig.3

1.2 How a gas spring generates a force:-

In a gas spring the way in which force is generated when you push in the piston. Suppose you cover the end of a push on the piston. Immediately find there's a force pressing outward against your hand, because the pressure of the gas on one side of the piston rod is higher than the pressure of the air on the other side. Or the force is produced by a difference in pressure on the two sides of the piston rod or piston

2. GAS SPRING PARTS AND GROOVING TUBE

A: GAS SPRING PATR'S

1) **Rod***:* In gas spring, piston rod is mane role of part. Piston rod have both side thread. One side of thread uses for assembly child parts like piston, valve disc, piston ring. Show in fig.1.2 piston rod height, diameter thread size is depended on the gas spring model for example: - gas spring model is YE3 and piston rod height is 188mm, diameter 2mm.

2) **Tube***:* A gas spring tube comprises a high-integrity gas process storage capacity. Stainless steel 304 pipe is a metallic pipe made up of a stainless steel .18% chromium, 8% nickel in the composition. And this tube both sides have chamfering first side chamfer use for folding to wield of pin. Second side chamfer for assembly piston and sealing process. Or seal the tube & Tube height, diameter is depend on model wise.

3) Oil: In gas spring common oil using. Oil name is C1 Oil have different-different amount or depending on models fill in gas spring. Oil amount in cubic centimeter use for smooth working process. To use between piston rod & tube (Ex. - YE3 = 4CC, X451 = 2CC, ETC

4) Valve disc: The disc is the part allows. Valve disc stops flow for oil, valve disc have 2 side box hole. To absorb oil inside 2 side box oil, Valve disc assembly in the piston wield and piston ring.

5) Piston ring: A piston ring work for support piston and valve disc when piston rod compressed the air that time valve disc have load form air to opposite direction. This ring assembly mount between valve disc and piston on rod.

6) Seal Retainer: is helps join the tube & piston rod together by seal retainer. Use for piston rod in working process don't come out side of tube.

7) Oil seal: - oil seal also call washer, is a ring made of rubber used in rod with assembly. It is used to prevent vibration from spreading from one part to another, reducing the noise levels. And oil seal is one-way seal to block air & oil.

8) Rod guide: When rod working process that time piston/rod not moving offset or work in smooth. Rod guide position between seal retainer & tube seal. As per same work oil seal.

9) Nitrogen Gas: Nitrogen use in gas spring, work properly and nitrogen gas not heated on a working timing.

2.1 Grooving tube:

Why using grooving?

Basically, every gas spring have oil and gas. When Gas flow down side or as work on piston to push down side. That time compressed gas going to heated so tube need stable on surrounding atmosphere, so some gas goes to upside or bypassed this nozzle, called to grooving on tube. Or 'V' shape of nozzle. As show in fig. 3

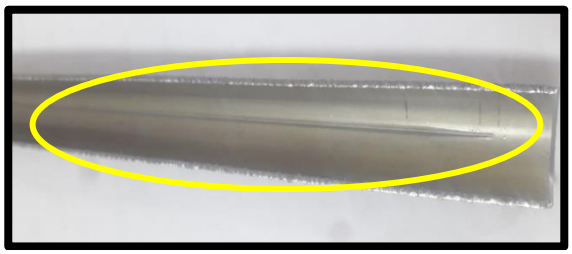


Fig.: - 3 testing Cut tube "V" shape nozzle

2.2 Literature review:

Table: - 1

Sr.No.	Author	Paper what say?
1	Divyesh D. Panchal, Alpesh M. Patel	It is necessary to optimize the process parameters of bending and important influence factors for system stability. The common issues in pipe bending are regarding wrinkling instability at the intrados, wall thinning (cracking) at the extrados, spring-back phenomenon, and cross-section deformation, forming limit and process/tooling design or optimization
2	EIRIK LIND HÅNES	The master thesis is written in cooperation with Resonator AS, which is a company that is developing a resonating free-piston tubular permanent magnet linear machine. They are researching the use of such a machine for down-the-hole (DTH) percussion drilling.
3	K. Santa Rao	The composite is a structural material that consists of two or more combined constituents that are combined at a microscopic level and are not soluble in each other to increase the strength of the material.

4	Yijie Chen	The mathematical model of the oil and gas spring was simulated by software MATLAB, compared with the external characteristic test data of the developed product

2.3OBJECTIVE

1) Find the why tube is bend? 2) How to avoid tube bend?

When grooving machine/tool work for mark of "V" shape nozzle inside Tube ,that time tube is bend(show in fig 5 in 3D model), bend tube not work properly also gas not fill as per given amount. And also tube is move to upside, not fix properly fixture. Next step "tube bending" is go to assembly process, when bended tube assembly and working time tube make noises ,gas ,oil leakage so than this tube to rejection parts.

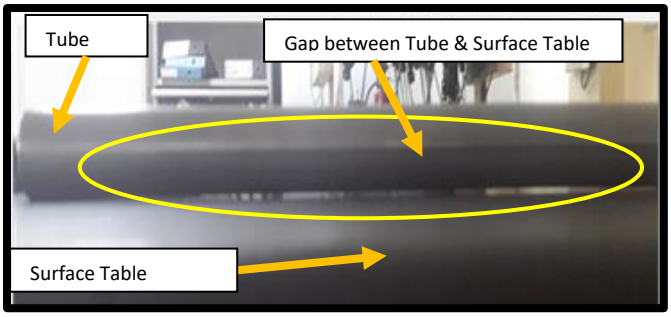


Fig.:-4 tube Testing tube on old machine

2.4 PROBLEM STATEMENT

Grooving tool apply force/load, load is 15 N. Inside tube for 'V' nozzle, after grooving tube are automatic tube bend in 2 sides. Load are depending model wise. Example: - YE3 Load 15N.

Bending tube not ok for working process because inside the tube have gas, oil, and piston rod. They are not work properly.

2.5 MODEL ANALYSIS :

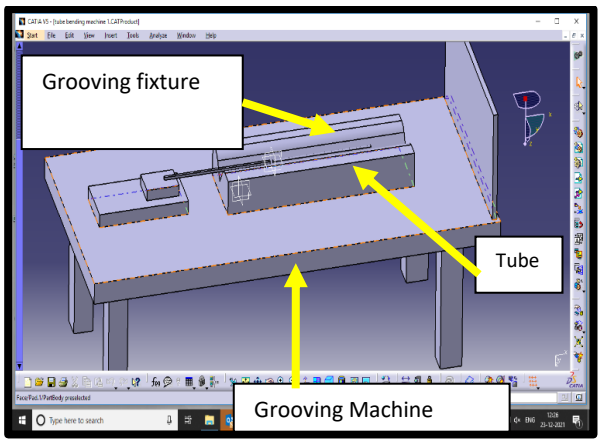


Fig: -5 Old grooving machine

Old Grooving machine have lot of rejection as well as cost showing in table.2

Table: - 2 old model cost as per months for rejection

Gas spring model's	Rejection part's	Cost
YE3	620	310000
X451	850	425000
XO-O	760	380000
XO-W	770	385000
Total	3000	1500000

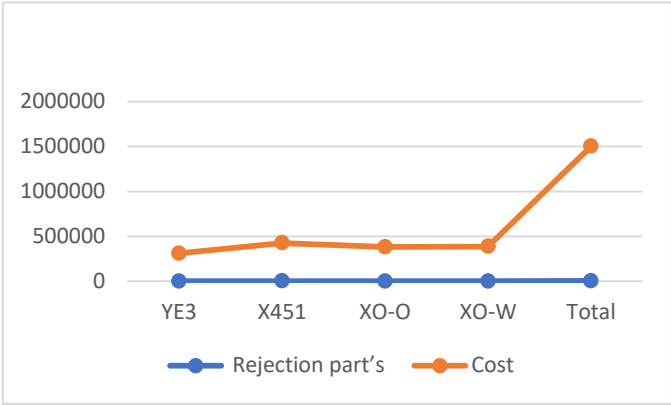


Chart -1 :Month Rejection Cost

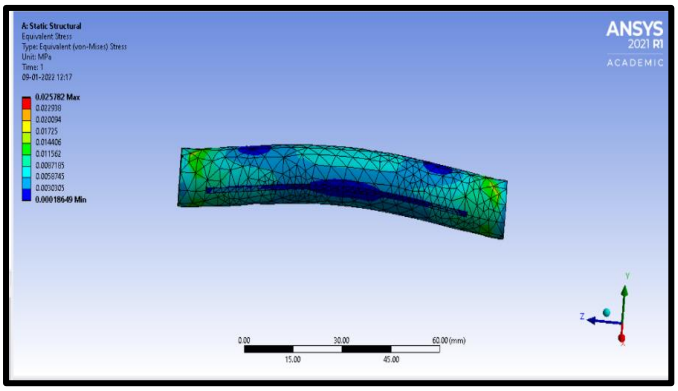


Fig: 6 testing bend tube in ansys (Equivalent stress)

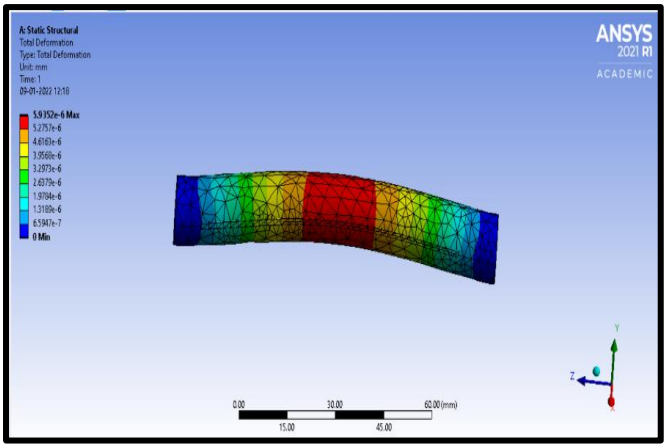


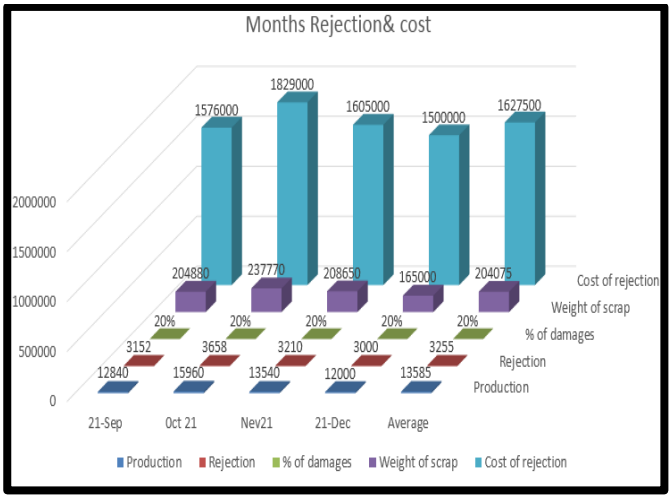
Fig: 7 testing bend tube in ansys (Total deformation)

In fig 6 & 7 showing the testing bend tube by applying load 15N. Use in ansys software, to check exact where tube is bend and who to working.

Show the Fig: - 4 tube is bend test on surface table. As show in given fig. gap between tube & surface table. Rejection pars (gas spring) Weight for YE3 = 20KG, X451=15KG, XO-O=15KH, XO-W=15Kg.

Table: 3 cost of all model in months

Month	Production	Rejection	Cost of rejection	Weight of scrap	% of damages
Sep21	12840	3152	1576000	204880	20%
0ct 21	15960	3658	1829000	237770	20%
Nev21	13540	3210	1605000	208650	20%
Dec21	12000	3000	1500000	165000	20%
Average	13585	3255	1627500	204075	20%



Graph 2 : Months rejection & cost

2.6 Tube Experiment on new grooving machine :

New Grooving machine update for tube support, tube not moving any side also called new fixture or piston machine, this piston machine mount is top view on tube fixture as well as grooving tool and machine working process is rod work down & up side

When piston rod goes to down side than rod applying presser/load on tube tube end to end, and after Grooving tool going inside the tube to mark "V" shape of nozzle. After nozzle work done, grooving tool come back as well as new piston rod come back. Purpose for new piston rod machine holds on tube, so no tube bend as well as tube not moving marking time or on grooving timing. As well as shown in fig.-15

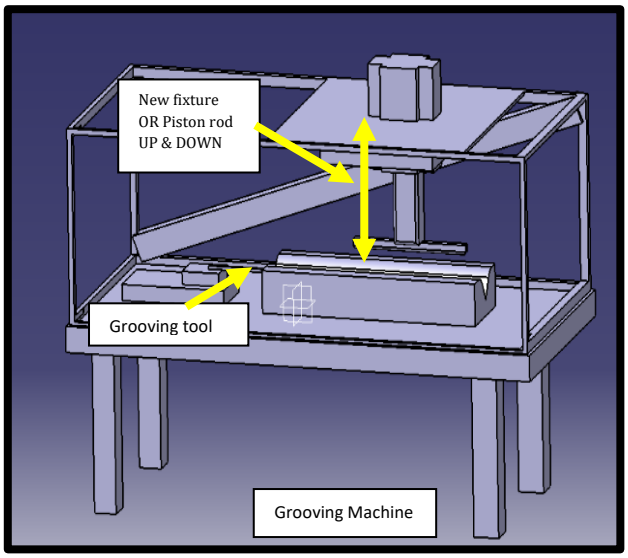


Fig.: 8 New Grooving machine

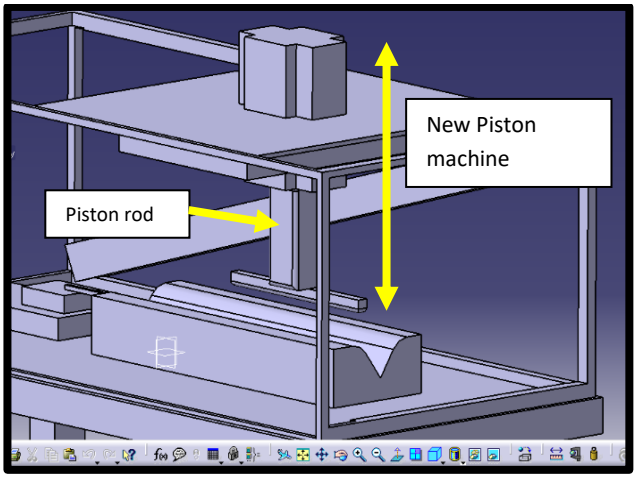


Fig.: 9 New grooving machine – Front view

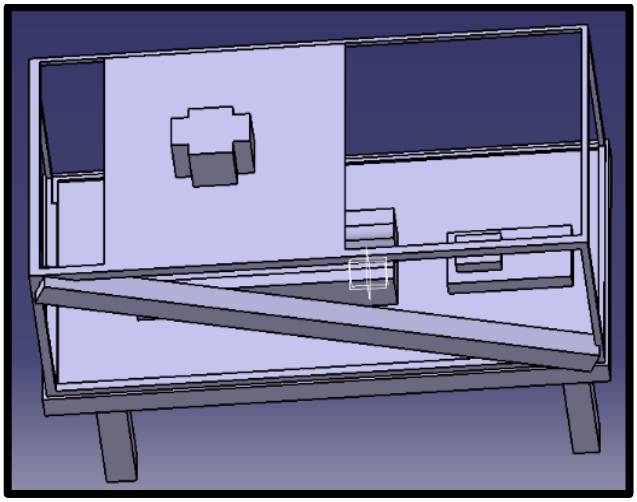


Fig.: 10 New grooving machine – Top view

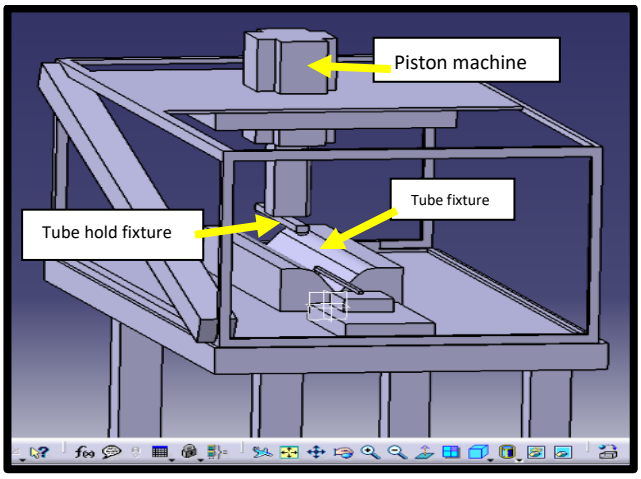


Fig. :11 New Grooving machine – Side view

Result: - Now new machine applying for stop tube bending there is no rejection parts for all models & save of the cost of models 1500000 per months.

But new machine also has minimum size of tube bend, this bending tube is "OK" for all part's & working process no issue. As show in table 4.

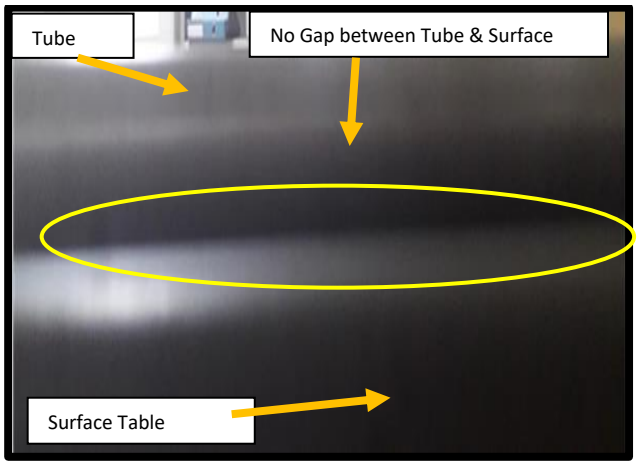
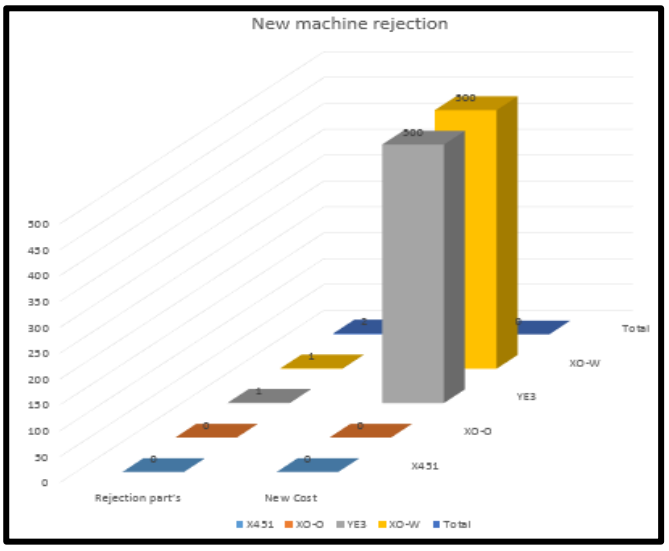


Fig.: 12 New tube test

Table: 4 New machine rejection all model & cost

Model gas spring	Rejection part's	New Cost
YE3	1	500
X451	0	000
XO-O	0	000
XO-W	1	500
Total	2	1000 ₹



Graph: 3 New Months rejection & cost

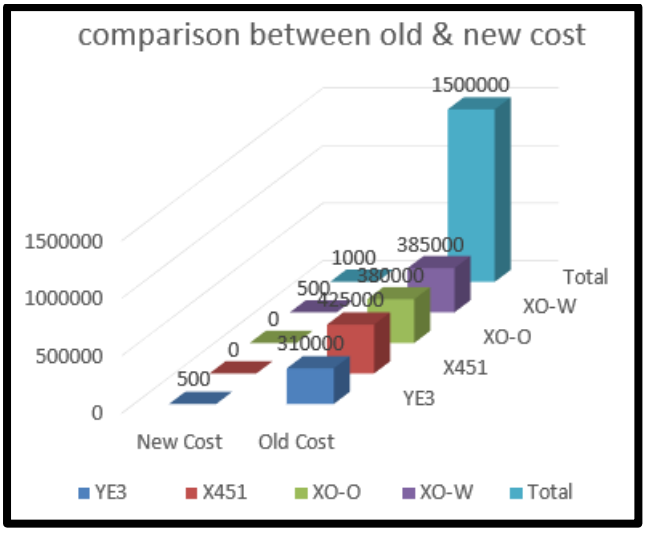
3. CONCLUSIONS

Old grooving machine have lot of rejection as well as cost & timing. Every model has same problem is tube bending. This tube bending come to grooving timing. Tube grooving is "v" shape for not smooth working inside piston, oil & gas.

Now the new grooving machine applying to new fixture. This new fixture also called piston machine. Piston machine working or apply to presser or load on tube and,

then grooving tool groov inside tube. New machine saves the rejection & cost as well as timing.

Also look the comparison between old & new cost in graph.



Graph: 4 comparison between old & new cost

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