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DESIGN AND DEVOLOPEMENT OF MOTOR MOUNTING FIXTURE FOR EFFECTIVE MOTOR-COMPRESSOR ALIGNMENT

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Abstract - *In industries, administration mainly focuses on improving productivity. This is done by reducing unproductive time. A committee does survey and find out this unproductive time. In order to reduce unproductive time, we proposed a design of flexible mounting fixture for different types of motor to optimize the current alignment process. In this paper, we are going to explore conventional setup & its problem, proposed set up and design methodology of the new technique.*

Key Words: - ***Productivity, Flexible mounting fixture, Motor, Alignment, Proposed set up, Design methodology.***

1. INTRODUCTION

Kirloskar Pneumatic Company Ltd. mainly produces compressors and gears. In machine shop, worker needs to do the alignment of compressor and motor. While doing alignment of motor pulley and compressor pulley workers use cranes to move motor in linear motion. Based on trial and error method, operator aligns motor and compressor. This method is time consuming.

Fig 1.1 Motor compressor setup

Problem Definition

Currently alignment is done by string method. The motor is moved by using high capacity industrial cranes. For proper alignment motor is adjusted by using crane as well as hammer. This is very time consuming process and causes fatigue to workers. This directly affects the productivity.

Motor mounting fixture

Primary purpose of motor mounting fixture is to create a secure mounting point for motor, allowing a support during testing of assembly and increasing accuracy of operation. It also serves to reduce setup time by eliminating complexity of process.

Conventional setup

Conventional setup consists of 8 test beds for testing of compressors. Compressors are tested with motors of the ratings 45KW, 55KW, 75KW, 90KW, 110KW, 187KW. Before testing, worker needs to do alignment of compressor and motor pulleys. While aligning motor pulley and compressor pulley, workers use cranes to move motor and use hammers to adjust motor position. This method is time consuming and exhausting because of trial and error operation.

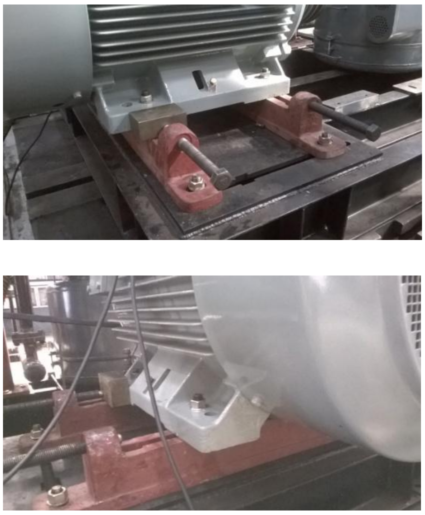


Fig 1.2 Current motor mounting fixture

Process flow of conventional method

Arrival of motor from store

⇩

Lifting motor with crane
(2 minutes)

⇩

Placing motor on fixture with help of crane
(5 minutes)

⇩

Fixing motor with nut bolt
(5 minutes)

⇩

Adjust motor position with crane and hammer
(10 minutes)

⇩

Alignment of motor and compressor pulley by string
(20 minutes)

⇩

Installation of V belt
(2 minutes)

⇩

Giving initial tension to belt by adjusting motor and providing spacer blocks
(15 minutes)

⇩

Securing the motor in place with nut and bolts
(5 minutes)

⇩

Securing tensioner to maintain initial tension
(5 minutes)

⇩

Again checking alignment before operation
(2 minutes)

Hence total time required is 71 minutes. Hence this makes the alignment method more exhausting. To tackle this problem and reduce operation time, new design is proposed. This design is more flexible and makes use of linear motion guideways for motion.

2. PROPOSED SETUP

Proposed setup uses linear motion guide ways for easy movement of motor during alignment. Standard components in Linear Motion (LM) guide ways technique are rails, block and lead screw. LM guide ways consist of standard rails and block for easy linear motion. Blocks containing recirculating balls are mounted on rails. When load is applied on the blocks, balls which are present in the blocks get in contact with the rails for easy movement. Two blocks are mounted on single rail hence two rails and four blocks are required for alignment and same for tensioning. Upper two rails are used for alignment with the help of two lead screws while lower lead screw is used for tensioning. This eliminates the use of crane and hammers during alignment and hence effectively increases productivity by decreasing operation time.

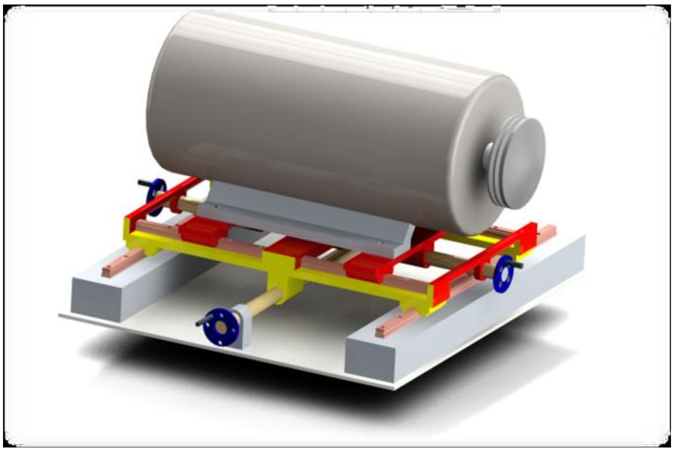


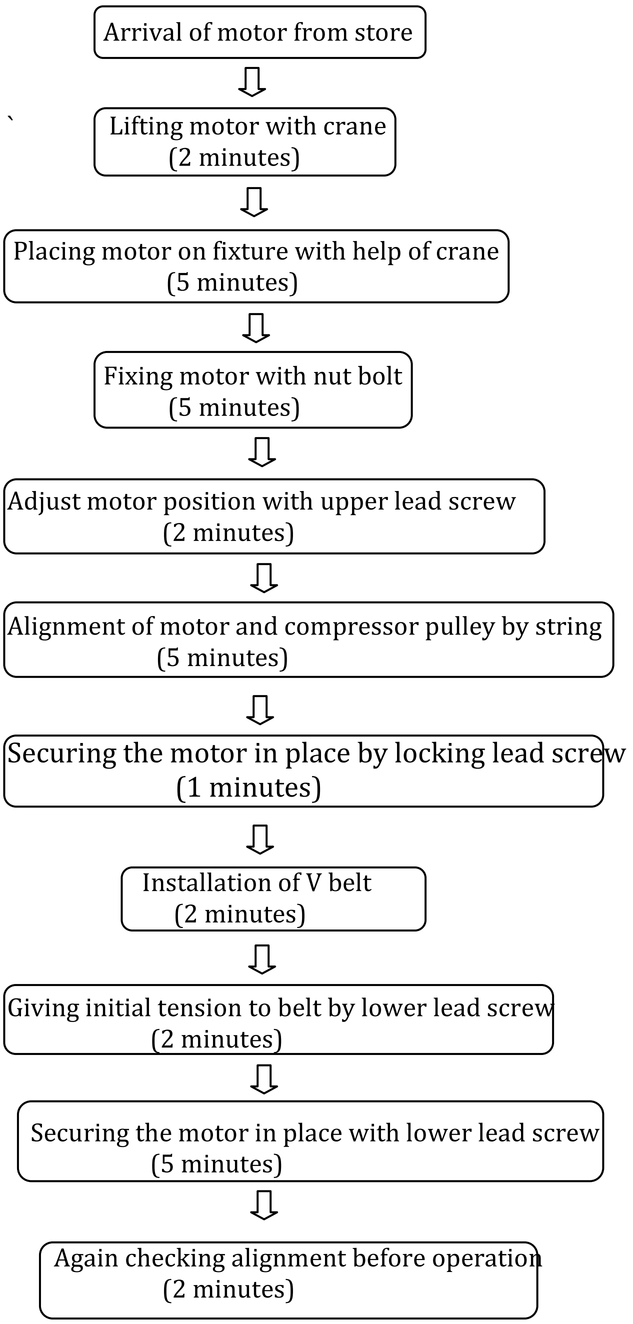
Fig 2.1 Design using linear motor guideways

3. PRINCIPLE OF OPERATION

Linear motion guidways are made up of hardened steel. Main components of LM guideways are rails and blocks. Rails are having specific profile which makes motion of block easier. Blocks contain number of balls which act as recirculating balls. The trains of balls are designed in such a way that a contact angle becomes 45°. This enables it to bear an equal load in radial, reversed radial as well as lateral directions. Therefore, it can be applied in any installation direction. In addition, MSA series can attain a well-balanced preload for increasing rigidity in four directions while keeping a low frictional resistance. This is mainly suit to high precision together with high rigidity required motion.

The lubrication route allows the lubricant evenly distribute in each circulation loop. As a result, the optimum lubrication can be successfully brought in any installation direction, and this fosters the performance in running accuracy, service life, and reliability.

Process flow of proposed method



Hence estimated time required for alignment is 31±5 minutes. Hence productivity increases. Effort required for this process is considerably less.

4. Design Methodology

Design methodology includes design of following parts
1. LM Guide ways
2. Power Screw
3. Bearings
4. Hand wheel

4.1 Design of LM guiderways

a. Parameters
- ❖ Space available = 1x1m
- ❖ Size
  - Maximum span – 1m
  - Number of carriage – 2 stage
  - Installation position – horizontal fixed to base
- ❖ Imposed load
  - Vertically downward motor weight
  - Maximum upto 1 ton
- ❖ Duty cycle
  - Apporoximately 15 hrs per day
- ❖ Moving speed
  - Approximately 0.12m/sec
- ❖ Service life
  - Moderate service life
- ❖ Operating condition
  - Temperature 30 ^{0}c
  - Indoor application
  - vibration

b. Type
- Linear slide with ball screw
- Blocks with tapping

c. Equivalent load
- Same load acts on each block hence equivalent load is 1 ton

d. Static safety factor

$F_{sl} = C_0 / P$

Standard value: 3-5 for impact and vibration

C_0 - Basic static load rating

P – Load

e. Nominal life

$L = (C/P)^3 \times 50$ Km

Practically

$L = [F_n \times F_t \times C / F_W \times P]^3 \times 50$ Km

f. Stiffness

- Fastening Methods
- Preloading
- Rigidity of fastened area

g. Belts used in company

- SPC 4500 fenner make
- SPC 5300 fenner make

h. Design requirement

- Height of mounting fixture should not exceed 25 cm
- Maximum level 1 m

i. Lead screw for locking and movement

- Design of lead screw as per guideway selection

4.2 Power screw design

In power screw application, by considering effort applied at screw and load lifted by thread, for a single start thread

$\alpha = \tan^{-1}(p/\pi dm)$

where,
root diameter d_r = d-p ,
thread thickness at root t = p/2,
shearing area per thread in screw = $\pi d_t \times t$,

number of thread in nut supporting the load are given by,

$n = l_n/p$ = Length of nut/pitch

The minor diameter of screw can be calculated from the formula

$\sigma_a = 4F / \pi d_r$

$\tan\alpha$ = lead (p) / πd_m.

Diameter of wheel (D):
{Total torque required to move the load} = 2 x {Force required at two ends of flywheel} x {Diameter of wheel}

4.3 Bearing selection

The single row deep groove roller bearing was selected. It is selected because of its effective increased load capacity when forces are applied in radial direction.

5. FEM ANALYSIS ON LM GUIDEWAYS

The analysis for linear motion guideway that is, rail and block assembly is done by using ANSYS R14.5 for estimating total deformation and equivalent stress. Meshing was done as pre-processing and for final results load is equally distributed on blocks.

The below figure shows pre-stressing of LM guideways. In this analysis, we considered guideway as beam and meshing is taken automatic meshing. Meshing is done for diving the model into number of node points which helps for analysis of load on each point.

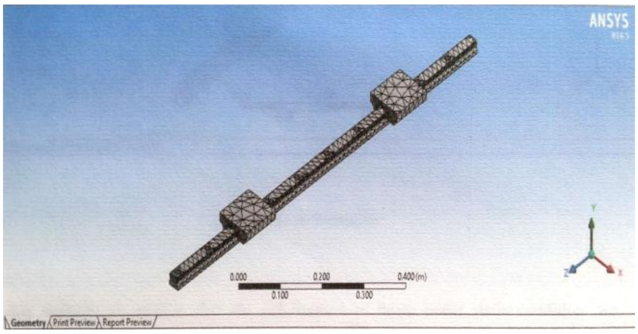


Fig 5.1 Meshing (Pre-processing)

Total deformation Analysis

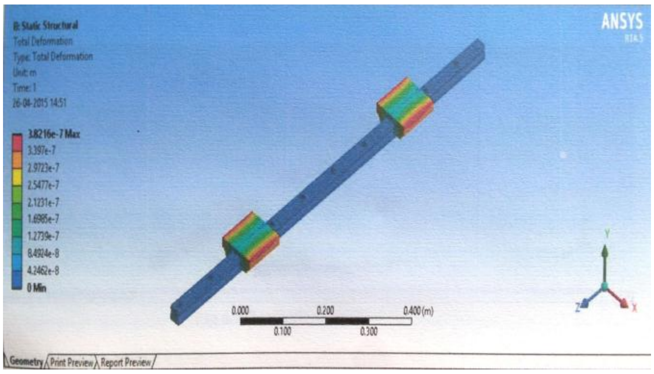


Fig 5.2 Total Deformation

In this analysis, we analyze that the deformation of beam under static condition. We consider the load on each block is 2500N. After applying load the results are as shown in figure. The result shows that the deformation of beam is 0.0003821m which is negligible. Therefore from this analysis it is see that deformation of beam is within permissible limit and it is suitable for given application.

Firstly, we considered the meshed beam for analysis, after that we applied the force on each block within is

2500N. Then the analysis is done for deformation of beam. The results are as shown in figure 5.2. in which stress zone are shown by different colors. Red color shows maximum deformation area. But from figure it is clear that maximum deformation is very less which can be considered as negligible.

Equivalent stress

After the deformation analysis, we did analysis for equivalent stress. In this analysis, we get results for this stress distribution on the beam. The results show that the equivalent stress is 1.12 MPa which is within allowable range. So, from this result we concluded that the guideway is safe for design from stress point of view.

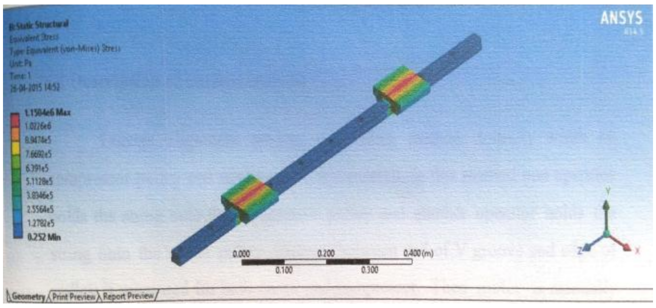


Fig 5.3 Equivalent stress

5. RESULTS

Parameter	Values
Total Deformation	0.00038216m
Equivalent Stress	1.15 Mpa

6. REFERENCES

[1]R. B. Patil., Mechanical system design, [NPUMECH30](Book code: PE175A).

[2] R. S. Khurmi. & J. K. Gupta, Machine Design, published in 2005.

[3] V. B. Bhandari., Design of Machine Elements, Third Edition.

[4] S. S. Rattan., Theory Of Machines, Mc Grew Hill Education Pvt Ltd.

[5] Vijaykumar Jatti and Mandar sapre., Finite Element Analysis.

[6] Manjushree D. Sutar et.al., A Case Study on Aluminium Extrusion Press: Problems identified and Probable alternative solution for its problem related to guideways.