



## International Journal of Intellectual Advancements and Research in Engineering Computations

### Design of Shaft Straightener with Travelling ram

Mr. Balakumaran M<sup>1</sup>, Karthik K<sup>2</sup>, Praveen M,<sup>2</sup> Vengatesh M<sup>2</sup>, Harish Kumar S<sup>2</sup>  
Assistant Professor<sup>1</sup>, UG Students<sup>2</sup>

Department of Mechanical Engineering, Nandha Engineering College, Erode- 52, Tamilnadu, India.  
balamadhesh@gmail.com, vengateshsethu95@gmail.com

**Abstract-** This paper deals with improvements in shaft straighteners. It is particularly for straightening the shafts used in the submersible pumps which become bent in service. It has been found that the shafts of submersible pumps become bent from various causes and however the shafts being bent from end to end. The method used before for correcting this condition usually involved hydraulic press, in that deflection is measured separately by using dial gauge and removed separately by using hydraulic press. Such a method however is objectionable as it is not only slow and laborious but also produces uncertain results. The present method of removing the deflection from a shafts by using experimental set up consists of hydraulic jack, travelling ram with bearings and dial gauge are being placed over the bed with guide rail. This method is most suitable and needs less time for removing the bends in the shafts.

**Index words-** hydraulic jack, submersible pump, shaft straightener, travelling ram

#### 1. INTRODUCTION

A submersible pump is a pump that can be placed underwater and still carry out its intended purpose. Some pumps may be designed to work while being fully submerged, and others may be submerged or placed in a dry place. It is necessary to know the type of pump which you are dealing with in order that no damage is incurred when it is being used. There are two mainly types of submersible pumps, sewage pumps and sump pumps. They are the types with which most residential users will see the most. It is able to be used in some of other applications such as fountain pumps, borehole pumps and well pumps. It protect the motors from the liquid being pumped when they are working. The motors are usually placed in a water tight compartment filled with oil, and most motors are electric. It are more efficient than jet pumps. There are various elements used in the submersible pump from that hexagonal shaft is important one.

Shafts are a basic, important and very common machine element. It is usually designed to perform a specific task in a specific machine. There may of course be thousands of similar machines produced,

each using a shaft of that design, and the manufacturer may provide extra shafts as "spare parts", but that shaft design generally has no use outside the machine for which it was designed. It follows that designers will frequently be called upon to design shafts and it is therefore important for them to understand the requirements of shafts and the design features needed to fulfil these requirements. Since shafts take on several different configurations and are used for many different purposes. Small diameter hexagonal shafts, such as, for example, shafts which is used in the submersible pumps, are subject to bending which can occur during manufacturing, processing or in subsequent use.

Straightness in shafts is of primary concern in submersible pumps that operate at high rotational speeds and have internal liquid sealing clearing of only a few thousandths of an inch. An un-straight shaft can result in:

- a) Excessive pump vibration.
- b) Seizure of the internal metallic components.
- c) Improper coupling alignment between pump and driver.
- d) Cyclic bending fatigue and shaft failures.

#### 2. PROBLEM IDENTIFICATION

The problem, that we are identified in the shaft bend removal process, which is carried out in the fabrication section of submersible pump manufacturing plant. In that section, the process which is currently in use is slow and tedious. So the production gets affected.

#### OBJECTIVE

The primary objective of the present invention is to provide a simplest method for straightening the shafts without any difficulties. Another objective of the invention is to increase the production rate of submersible pumps by reducing the time consumption of shaft bend removal process.

#### 3. METHODS OF CORRECTING SHAFT RUN OUT

Straightening shafts can be an issue either during initial manufacturing or as discovered during an inspection of the pump at repair. Specifications—such as ANSI, API, PIP and others—impose limits on shaft straightness, but generally (unless an unusually long and slender shaft).

Anything over 0.001 inch/0.002 inch is considered excessive. Manufacturing errors are unfortunately made, and machine shops routinely face a dilemma of either having to replace a shaft with a new one or strengthening a bad (bent) shaft. Three main methods can be used to straighten a pump shaft:

- Hot Spot Method
- Peening Method
- Cold Straightening Method

### 3.1 HOT SPOT METHOD

The hot-spot method involves quickly heating a local spot (on the outside of a bend) to an elevated temperature. As a result of the local heat, the heated region tends to expand, but also due to the elevated heat, the yield strength of the material is reduced. Due to these combined effects, the metal yields such that the shaft bulges slightly in the heated region. When the heat is removed, the metal then hardens and remains in the bulged position and the residual tensile stresses introduced into the outside of the bend of a shaft tend to straighten the shaft. The hot spot method is characterized by the following intrinsic disadvantages:

1. The heating process is not accurately controllable. There is no precise method of determining the amount of heat applied to the shaft.
2. The metallurgy of the shaft can be adversely affected.
3. The process is extremely slow; after each heating the entire shaft must be allowed to cool to a uniform temperature before the results can be assessed.

### 3.2 PEENING METHOD

It is a hammer or equivalent technique used to hammer orpeen the shafting surface on the inside of a shaft bend. The residual compressive stresses thereby introduced into the shaft tend to straighten the shaft. The peening method entails the following intrinsic disadvantages:

1. The magnitude of the peening effort required to straighten shafts of large diameter, especially those of high tensile strength, exceeds that which can be accomplished with the usual peening techniques.
2. The residual stresses introduced into the shaft are distributed non-uniformly.
3. Due to the superficial nature of the compressive residual stresses introduced, efforts to improve the surface finish of the shafting after peening by cutting a small amount of metal from the shaft will

tend to destroy the effect achieved because the residual stresses in the metal removed from the shaft will not be uniform around the circumference of the shaft.

## 3.3 COLD STRAIGHTENING METHOD

Hydraulic press and proper supports are the means for straightening the shaft until it agrees with permissible tolerances. The shaft is stored for 48 hours and then re-inspected. If the shaft is out of tolerance on total indicator run out, it is discarded; no further straightening is allowed.

### 3.3.1 ADVANTAGES

- The cold straightening method comes closer to correcting the root cause of the problem for many applications. For this reason, the cold straightening method is often considered as the first choice approach.
- The results can be monitored easily and directly throughout the process by observing the dial indicator reading. For a given shaft, the amount of required correction is relatively consistent and repeatable.
- This method does not require the use of heat, it can be used on a wider range of shaft materials than the spot-heating process.

## 4. RESULTS AND DISCUSSION

In this above method of the straightening processes clearly brings out the merits and demerits of cold straightening process. Based on that, we have designed a new set up for the straightening process.

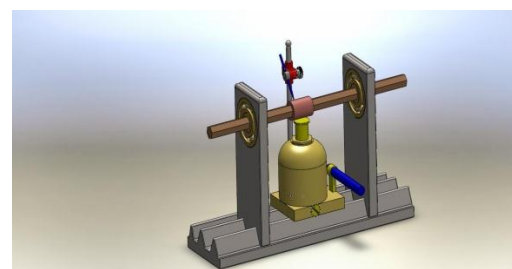


Fig.4.1 3-Dimensional model of shaft straightener  
Fig.4.1 shows that the 3- Dimensional model of the shaft straightener setup. In this setup hydraulic jack, travelling ram with bearings, and dial gauge are vertically mounted on the moving guide rail bed.

## 5. CONCLUSIONS

This paper presents a method for straightening the pump shafts easily and accurately. In this method cold straightening process is used for straighten the pump shafts. The experimental set up which consists of hydraulic jack, dial gauge,

travelling ram, and bed with moving guide rail. The main advantage of these setup is flexibility, which means all the components are movable. So this method is best suited for straightening the pump shafts.

#### REFERENCES

- [1] Das Talukder, N. K., and Johnson, W., "Bar Straightening Process by Reverse Bending," Research Monograph No. 79121, Mech. Engr. Dept., Banaras Hindu University, Varanasi, 1979.
- [2] Das Talukder, N. K., and Johnson, W., "On the Arrangement of Rolls in Cross-Roll Straighteners," *Int. J. Mech. Sci.*, Vol. 23, pp. 213-220, 1981.
- [3] K. Kawai, M. Hayama, Recent development of rotary forming in Japan, *Int. J. Mach. Tools Manuf.* 29 (1), 1989.
- [4] N. K. Das Talukder and A. N. Singh., "Mechanics of Bar Straightening, Part 1: General Analysis of Straightening Process," *Journal of Engineering for Industry*, Vol. 113/227, 1991.
- [5] N. K. Das Talukder and A. N. Singh., "Mechanics of Bar Straightening, Part 2: Straightening in cross roll straighteners," *Journal of Engineering for Industry*, Vol. 113/228, 1991.
- [6] The Japan Society for Technology of Plasticity: Straightening of Metal Products, Corona Publishing, Tokyo, 1992 in Japanese.
- [7] T. Sano, K. Kawai, Activities of the JSTP committee on environmental issues, *J. Mater. Process. Technol.* 59 (3), 1996.
- [8] M. Kiuchi, Technology required for protection of the environment in the field of metal forming, *J. Mater. Process. Technol.* 59 (3), 1996.
- [9] K. Kawai, Y. Tatsuki, H. Kudo., "Rotary straightening of curved shape near both ends of seamless pipe," *Journal of Materials Processing Technology*, Vol. 140, 2003.
- [10] Graziella, K., Siegert J., and Westkamper, E., "Procedure to Improve The Understanding of The Rotating Straightening Process", *Journal of Machine Engineering*, 2. 570-576, 2011.
- [11] Kai Wanga, Baoyu Wanga, Chuancheng Yang., "Research on the multi-step straightening for the elevator guide rail," *International Workshop on Automobile, Power and Energy Engineering*, 2011.
- [12] Świć A., Gola A.: Economic analysis of casing parts production in a flexible manufacturing system, *Actual Problems of Economics*, 3 (141), 526-533, 2013.
- [13] Świć A., Taranenko W., Gola A.: Analysis of the process of turning of low-rigidity shafts, *Applied Mechanics and Materials*, 791, 238-245, 2015.
- [14] Antoni Świć, Aleksandr Draczew, Arkadiusz Gola., "Technology Of Heat Treating-Straightening Of Long Shafts With Low Rigidity," *Advances in Science and Technology Research Journal*, Volume 10, No. 31, Sept. 2016.
- [15] "A Text Book of Theory of Machines" by R.S.Khurmi.