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Review of Shaft Straightening Mechanism Processes

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Abstract: *A shaft is an element used to transmit power and torque, and it can support reverse bending. Most shafts have circular cross section, either solid or tubular. The difference between a shaft and an axle is that the shaft rotates to transmit power, and that it is subjected to fatigue. An axle is just like a round cantilever beam, so it is no subjected to fatigue. The success of a bent shaft straightening project is dependent on the type of bending that needs to be corrected*

Nowadays straightening of these commercial bars are done manually in industries by hammering process. It is a very tedious job and time consuming too. So there is an industrial necessity to automate the process. Three power driven vertical feed rolls advance bar stock through pairs of horizontal and vertical rollers in the first and second half of the machine respectively. The problems encountered during the process were the autorotation and spring back effect. The autorotation was solved by a three roller standstill locking mechanism. During the process of straightening, bars rotate around autologous axis, which cause out of the vertical of straightening surface and the straightening precision is deduced. To eliminate the auto-rotation of bars, parallel roller collocation scheme of cold rolled deformed bars with high speed and no scratches is presented.

1. INTRODUCTION

Now a day in every mechanical system like Pumps, turbine, etc. needs a shaft for power transmission. During various machining process because of some reasons shaft may bend in microns. Due to bending, shaft starts vibrating. A bent shaft can cause many pump problems including wear of supporting bushings, leaky seals, high vibrations, noise overloaded bearings. Vibration cause the loss of energy in the transmission of power. So parallel efficiency of those mechanical system goes on decreasing. We will design and analysis a system, to overcome that problem. This problem is given by Kalapi Engineering Works, Kupwad M.I.D.C, and Sangli. Now a days error involves in shaft exists in between 100-150 micron they will rejected per month 20-25 shafts get rejected due to run-out error. To reduce this problem the machine is required. By identifying this problem, we are trying to design and develop a machine to reduce the rejection rate and loss.

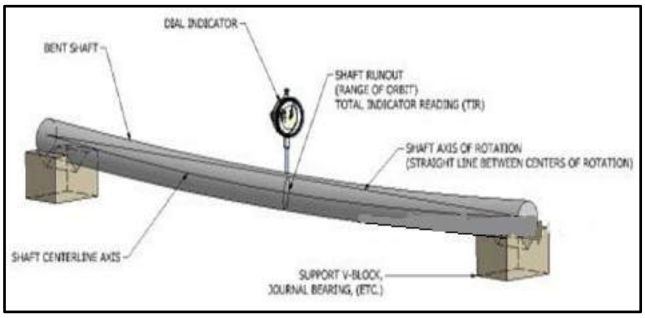

Fig 2.1 *Problem Sketch*

A shaft that is initially straight can bend due to stresses caused by heavy shrink fits with mating components such as a turbine wheel, for example. Bent shafts caused by assembly stack-up stresses are usually not correctable by simply straightening the shaft itself. The assembly needs to be analysed as a complete unit, and corrected accordingly. Sometimes, a change in the fits between the shaft and its mating components is required to accomplish the straightness needed. There are limitations, however, that determine which shafts may still be salvaged by these procedures, versus those that must be scrapped for a new shaft. These limitations include shaft size, material and the amount of initial distortion. Since all the methods involve correcting deformations beyond the elastic limits, some of the considerations include stresses imposed, changes in metallographic structure, micro-cracking and others. A post-straightening heat treatment is often required.

Unfortunately, none of the procedures can universally solve all shaft problems, and most repair facilities apply internal experience to decide which should be used. Because of this, many end users are reluctant to accept straightened shafts, fearing deformations will return once a pump is in operation. Horror stories are abundant and are equally matched by success stories of large and expensive shafts straightened, avoiding the production of a new (and expensive) shaft. Sometimes, depending on who is asked (repair shop versus OEM versus end user), different feedback on success (or lack of) of such operations will be obtained.

1.1 Shaft Straightening Mechanism:

In the straightening processes, bar is pre-straightened, and then its residual error reduces when it passes through the three-roll deformation. The deformation reaches equivalent curvature and it guarantees the bar doesn't rotate. At last, the bar is straightened via cyclic deformation in two orthogonal leveling flats, as shown in Fig.1. The wire rod of minor diameter bar adopts axial-feed technology, so the bar is twisted. The bend bar is used to setting-out before straightening and the torque of the bar is released, which causes the uncertainty of straightening plane because of autorotation of the bar. In the straightening processes, three roll deformation technology in this straightening system can keep the bar from rotating around its own axis, which insures that the two orthogonal leveling planes don't change and two-dimensional straightening is fulfilled. While curvature residual of the same bar reaches equivalent curvature, which guarantees the bar's straightening accuracy. There are two self-locking systems in the process and the feed force has to overcome the locking press force. The self-locking system is equivalent to a simply supported beam with load at centre.

1.2 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. That the straightness of 0.01 to 0.05 inch is accepted. Production errors are made, so the industries faces the problem of straightening the bent shaft.

Three main methods can be used to straighten a pump shaft:

A. Hot Spot Method

The hot-spot method involves quickly heating a local spot (on the outside of a bend) to an elevated temperature. Due to heat in the region tends to expand, and due to the elevated heat, strength of the material is also reduced. Because of these heat metal is totally damaged. The strength of the metal is getting damaged after the cooling process, because of the releasing of residual stresses.

B. Peening Method

It is a hammer or equivalent technique used to hammer or peen the shafting surface on the inside of a shaft bend. Compressive stresses are occurred in the shaft.

C. 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. Shaft is out of tolerances means, it is rejected.

2. LITERATURE REVIEW

The shaft straightening mechanism has studied by many researchers earlier. The study of literature has been done in literature review:

A.N.Singh has said that the mechanics of straightening of bars and sections with initial residual curvature distributed nonhomogeneously along the length of the bar by reverse kinematic loading can be dealt with graph-analytically. If the range of initial residual curvature of the bars to be straightened is known, then for a particular set-up of kinematic loading, the range of final residual curvature, i.e., the degree of straightness of the product can be ascertained. Conversely, if the desired degree of straightness is specified the required loading may be ascertained.[1] Jin Herong has said that during the process of straightening, hot rolled deformed bars rotate around antilogous axis, which cause out of the vertical of straightening surface and the straightening precision is deduced. To solve the problem of the bar's rotation, parallel roller collocation scheme of hot rolled deformed bars with high speed and no scratches is presented. Based on the theory of elastoplasticity large deformation, elastic recovery torque variety during the setting out of coiled bars is analysed in accordance with the triple-roller equal curvature rotation blocking straightening system. The mechanical model of bars in triple-roller is established and rotation blocking mechanism of the triple-roller equal curvature rotation blocking straightening system is researched. The results indicate that the system has the effect of consistent original curvature and rotation blocking to guarantee straightening precision and supply the demand of operation. [2] Arun Augustin has described in research paper said that the straightening process for MS bars of 10mm diameter, a precision of was achieved. Autorotation of bar was prevented using the standstill locking mechanism. Using commercial finite element software ANSYS, it was found that during the straightening process the bar undergoes maximum deformation at the centre portion whose value was within the allowable range. The stress developed in the bar was well within the permissible limits for steel material. The results show that the design proposal of straightening system which is proposed in this paper is feasible and it provides favourable theoretical foundation for the development of commercial bar straightening machine. [3] Arkadiusz Gola described new method of heat treating-straightening of long shafts with low rigidity. Analytical relationships for the determination of rectilinearity of shaft axis in heat treating-straightening are presented. A fixture for heat treating-straightening of shafts was developed. The experiment conducted as well as the calculations confirm high effectiveness of the developed method of heat treating-straightening of long shafts with low rigidity. Application of the developed technology of heat treating straightening permits minimisation of the value of deflection of semi-finished product and stabilisation of the level of residual longitudinal stress, which results in enhanced operational accuracy of long shafts with low rigidity, improved quality and operation parameters of finished products. [4]

3. 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.2 shows that the typical circuit diagram of set up. In this setup hydraulic jack, travelling ram with bearings, and dial gauge are vertically mounted on the moving guide rail bed

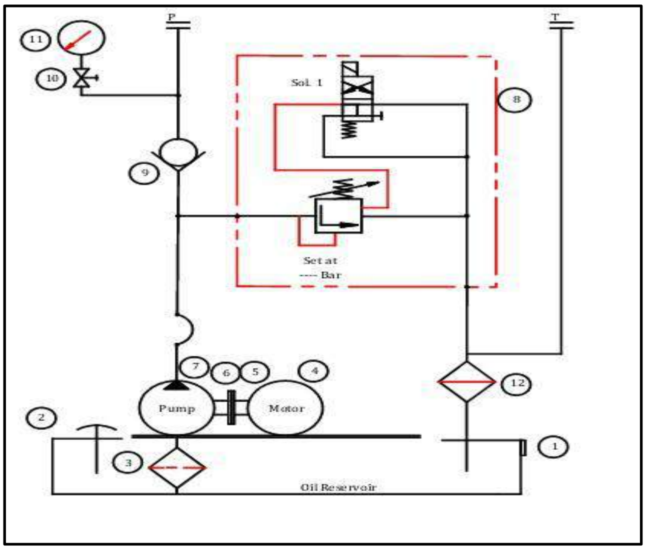

Fig. 2 *Typical Circuit Diagram of Shaft straightening mechanism*

The circuit diagram consist of following parts:

Sr.No	Components		
1	Oil Level Indicator	**7**	Hydraulic Pump
2	Filler Breather	**8**	Unloading block with DC Valve
3	Suction Strainer	**9**	Flow control with check valve
4	Electrical Motor	**10**	Gauge Isolator
5	Bell Housing	**11**	Pressure Gauge
6	Coupling	**12**	Return Line Filter

4. CONCLUSIONS

This paper presents a method for straightening the shafts easily and accurately. The cold straightening process is used for straighten the 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 shafts.

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