



Contents lists available at ScienceDirect

Engineering Failure Analysis

journal homepage: www.elsevier.com/locate/engfailanal

Failure analysis of spring of hydraulic operated valve

Urbi Pal*, Goutam Mukhopadhyay, Sandip Bhattacharya

Failure Analysis Group, R&D and Scientific Services, Tata Steel, Jamshedpur 831001, India



ARTICLE INFO

Keywords:

Spring
Fatigue
Surface defect
Manufacturing

ABSTRACT

The breakage of spring of a valve causes the non functionality of a hydraulically operated system which pours steel into tundish (controls the flow of steel before putting into a caster) in a steel manufacturing plant. The valve is operated with two springs of diameter 0.3 mm among which one was broken. The spring failed after 5 years of service which had expected life of 10 years. The fracture surface under SEM showed striations confirming fatigue failure. The chemistry of the spring was confirmed to be a plain high carbon steel consistent with the requirements of ASTM A228 “Steel wire, Music quality” which is a cold drawn steel wire for mechanical spring. The microstructural analysis showed crack associated with scale and crow feet. The presence of crow feet like surface defect acted as stress concentration for fatigue crack initiation. The valve spring activated 100 times per hour causing fatigue loading of the spring. The etched condition shows drawn pearlite typical structure of cold drawn spring and hardness was also found to be satisfactory. The presence of crow feet surface defect came from the wire drawing stage due to insufficient lubrication and considered to be manufacturing defect. The inspection of a spring this kind for critical applications should be robust to avoid future failures

1. Introduction

Springs of various design are used under different loads and deflections and the causes of spring failure likewise may be due to a wide range of factors. These factors can include excessive or off-axis loading, fatigue, corrosion, manufacturing flaws or a combination of these. The reasons of fatigue failure may be due to improper chemistry, surface defect, improper heat treatment, environment assisted corrosion [1,2]. In a steel making shop, the hot metal is held in a steel container called a turret and from the turret the steel flows in tundish. This flow is controlled by a hydraulically operated slide gate. The function of the slide gate is to adjust the flow when desired. This slide gate is operated by POCV valve (Pneumatically operated control valve). The slide gate malfunctioned and caused 12 h unplanned breakdown leading to production loss. After dismantling of the valve, one of the springs was found broken after 5 years of service life against of 10 years. The function of the springs is to help in the positioning valve during operation. The valve is controlled by two springs with a diameter of 0.3 mm. One spring was broken and the other was found intact. A Comparative study of both the springs was carried out. The schematic of the process flow and the location of failure is shown in Fig. 1. The location of spring in the valve is shown in Fig. 2. This paper describes the procedure applied and the results obtained of a failure analysis of a spring and determine the causes of its premature rupture.

* Corresponding author.

E-mail address: urbi.pal@tatasteel.com (U. Pal).

<https://doi.org/10.1016/j.engfailanal.2018.09.013>

Received 23 February 2018; Received in revised form 3 September 2018; Accepted 13 September 2018

Available online 18 September 2018

1350-6307/ © 2018 Elsevier Ltd. All rights reserved.

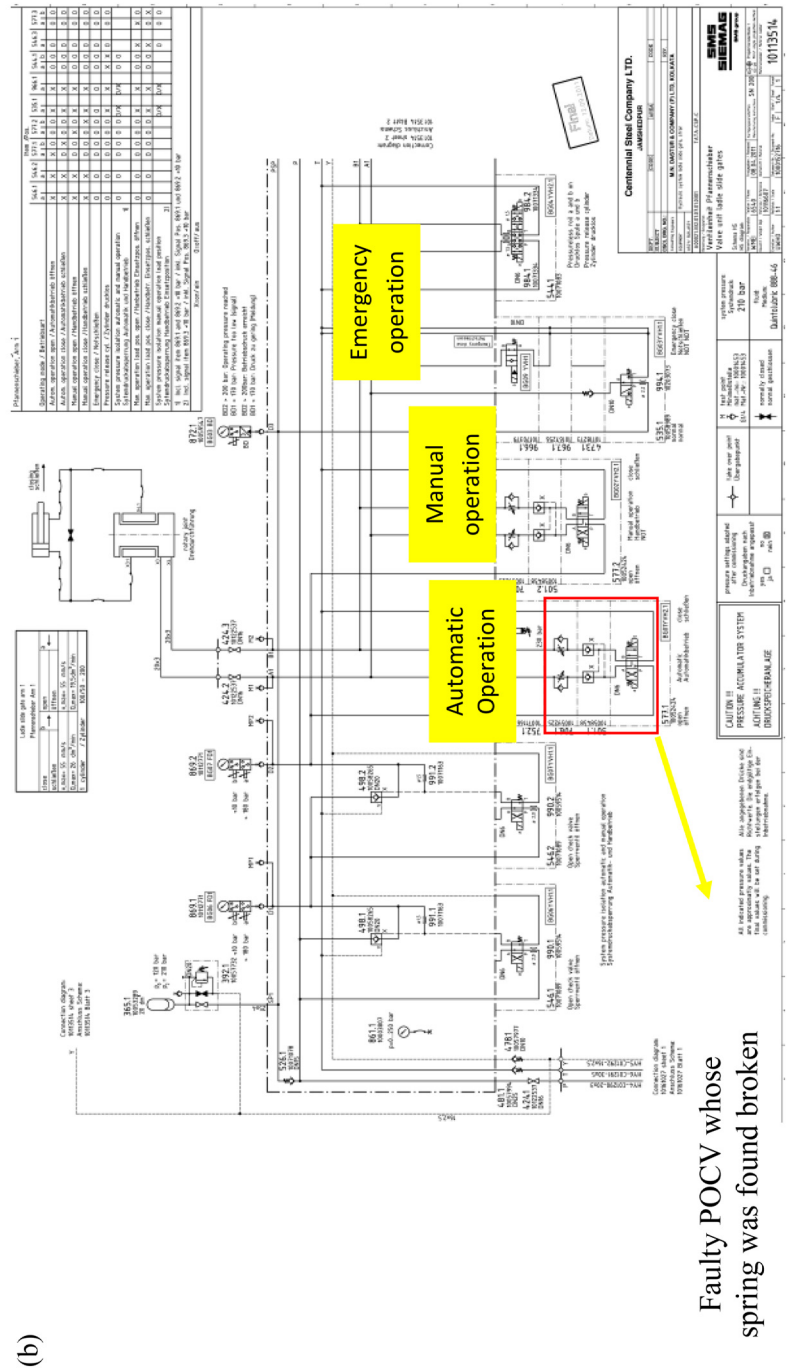
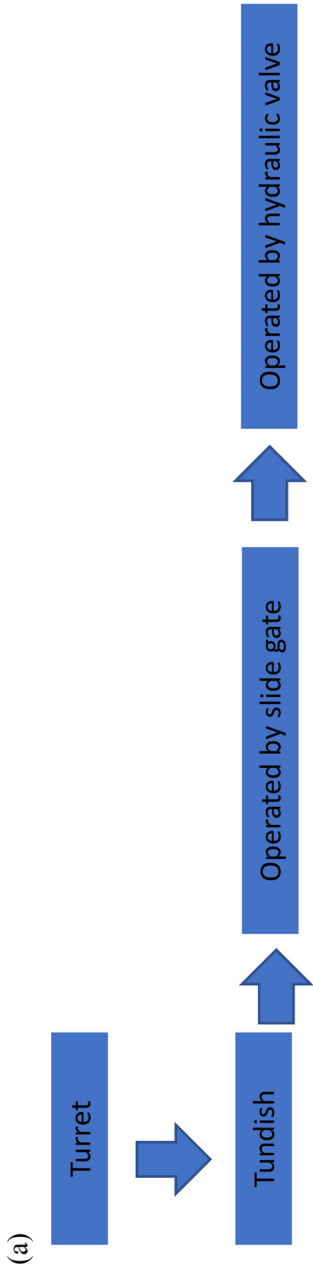


Fig. 1. (a) Flow diagram of Hydraulic Slide gate (b) Location of faulty valve in the circuit diagram.

Download English Version:

<https://daneshyari.com/en/article/11029910>

Download Persian Version:

<https://daneshyari.com/article/11029910>

[Daneshyari.com](https://daneshyari.com)