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Research paper

Development of Vibrator Feeding Mechanism Using Two Sets of Rollers for the Separation of Ball Grading For Industry Benefits

S.P. Sundar Singh Sivam [1]*, K.Saravanan[2], N.Pradeep[2], S.Rajendra Kumar [1],Shubhang Mathur1[1],Usama Dingankar[1],Anurag Arora1[1]

[1]*Department of Mechanical Engineering, SRM Institute of Science and Technology, Kancheepuram District, Kattankulathur- 603203, Tamil Nadu, India*

[2] *Department of Mechatronics Engineering, SRM Institute of Science and Technology, Kancheepuram District, Kattankulathur- 603203, Tamil Nadu, India*

**Corresponding author E-mail: legendsundar2k6@gmail.com*

Abstract

The study aims to provide an Automatic Feeder Machine to inspect the Ball diameter to eliminate any parallax error and to reduce the measuring time significantly also to create an ergonomic environment for the operator. The measurement of Steel Ball diameter which is very much important needs to measure 100% before assembly. The inspection is done manually by using Micrometer which takes more time and possibility committing parallax error by operator. The micrometer needs to calibrate with master very frequently. The micrometers are normally used to measures very precision parts in rare frequency only. The possibility of mixing up rejected with acceptable items is very common in this type of inspection. The balls which are measured manually are kept separately according to the ball diameters. Due to high measurement ratio of the balls, operator by mistake passes the rejected balls in to right balls. To avoid this problem, this study focused on to develop the automatic inspection machine of vibrator feeding mechanism for balls to improve the accuracy of inspection and reduce the inspection time.

Keywords: *Metrology, Low Cost Automation, Ball Grading*

1. Introduction

Time management is an important criterion for any industry. Optimizing time management and reducing the process time is the key goal to achieve maximize efficiency. Another important area of improvement is in reducing the measurement errors. Many measurement process in the recent days, are being automated to improve the measurement accuracy and also due to the fact that the measuring time is significantly reduced and thereby increasing the output. Steel Balls diameter inspection is being done manually by using Micrometer. It takes more time for inspection and prone to many parallax errors in inspection. So there is a growing need to overcome these constraints and explore the scope of increasing the efficiency. Hence to improve the accuracy of inspection and reduce the inspection time, Measurement time is high and low accuracy of measured balls for oil hole sealing operation in Power train shafts. So it does not meet Production requirement. And also high skilled operators only require for balls measurement. In order to avoid rejection ball due to pressing on the shaft by inspection method, automatic inspection machine is required. During inspection time, the ball is not properly locked by operator in the micrometer. In view of this, measurements not taken properly and balls are rejected [1-20]. Made accepted by the Operators and Accepted balls getting rejected by them.100% inspection by micro meter is not generally suitable for any component with feeding impossible at the right time. The calibration of micro meter is frequently required with master piece. In view of this production time is affected. In order to avoid these problems, automatic inspection withVibrator auto feeding mechanism is proposed to improve the productivity. The disadvantages of the using a micrometer is more inspection with rate of inspection only up to 10balls/min so compressive load happens in balls.

1.1 Need for study

These Balls are used in Oil Hole sealing for Power train shafts applications. These balls are graded by three dimensions according to the hole diameter in the shafts. Ball specification: Diameter 7.000 / 7.025 mm. here the Grading ranges are Grade 1 : 7.001 / 7.008 mm, Grade 2 : 7.009 / 7.018 mm, Grade 3 : 7.019 / 7.025 mm. The measurements of these steel balls were done by Digital Micro meters so tensile load happens in balls.

1.2 Construction and Machine

The machine is designed to provide maximum rigidity and accuracy to its two main cylinder rollers. They are made of steel alloy steel, precision machined to high degree of accuracy. They are hardened, tempered, precision ground and lapped after hard chrome plating, for giving them a long working life. The roller are housed in a robust housing mounted on high precision anti friction rolling bearings , which are precision to give high axial rigidity to these rollers an important prerequisite to obtain high operational accuracy on a continuous basis. The drive mechanism is exclusively designed to give the desired differential rotational to the rollers. This mechanism ensures that the components ahead while rotation about their own axis. This differential rotation is infinitely variable within the operation range .This also helps in setting the

highest performance level of the machine for different components under sorting. The rollers have to rotate in outward directions opposite to each other.

1.3 Rollers surface finish Geometric value after measurement

Fig. 1: Roller shafts

1.4 Rollers surface finish Geometric value after measurement

Fig. 2: Shaft surface finish measurement Report

1.5 Roller shaft setting Procedure

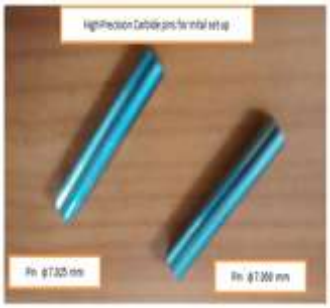

Fig. 3: Shaft Taper Setting Pins

Two roller pins are used for quick taper setting on the roller shafts. The diameter of pin varies according to the ball sizes which are to be measured are shown in Figure 3.

Fig. 4: Shaft Taper Setting Pins

The bolts of rollers shaft and other fasteners are loosened for adjustment. Two different diameter pins are used for roller shaft taper setting. The diameter of one pin is 7.000mm whereas anotherone is 7.025mm.Pins are placed as shown in the figure.The pin diameter with 7.000 mm is placed in starting of the roller shaft near to Motor drive. 7.025 mm diameter pin placed in the Distance of 200 mm from 7.000 mm diameter pin. Hence the required taper created between two rollers. Then the roller shaft is tightened and checked with master Pieces are shown in Figure 4.

1.6 Grading boxes defined based on Oil hole dimension

Table 1: Grading boxes defined based on Oil hole dimension

S.No	Grading Band	Length (mm)	Ball Size (mm)	Status
1	A-B	100	Below 7,000	Under/Size
2	B-C	66.6	7,001 to 7,008	Accepted - Grade 1
3	C-D	66.6	7,009 to 7,018	Accepted - Grade 2
4	D-E	66.6	7.019 to 7,025	Accepted - Grade 3
5	E-F	100	7,025 and above	Over/Size

2. Working principle

The segments are sustained persistently to the machine from a vibratory feeder. Here the parts which are stacked on the rollers of the machine are checked ceaselessly as for set size/measurement. The under size segments are arranged to begin with, and after that acknowledged parts are isolated from the larger than average segments toward the end. These three gatherings, for example, are precisely gathered in the assigned containers .If wanted, satisfactory range are ground to suit any necessity .To suit distinctive states of segments, custom-assembled guides are given in the machine itself to quicker out-put. Checking and Sorting Machine are Precision hardware and should be set-up in a clean free condition. An

incompetent specialist can undoubtedly work these machines. Hence productivity is expanded with no extra capital consumption. It additionally helps in decreasing dismissal by choosing the most positive "points of confinement " amid creation Also finished size parts can be rescued later on at an advantageous time without irritating the typical generation

2.1 Salient features of the machine

Quick change over from one component to another is possible. This is a Portable unit, infinitely variable speed, within the range, 100% quality control, and maintenance free and easy to operate. A skilled operator is not required. Quick setting change over, accuracy of measurement are highas all the balls are inspected. All accepted balls and rejected balls are identified and segregated faster than that of inspection by a man. Balls with various diameters are measured quickly. The time taken for set up changeover is very low.

2.2 Advantages of the Proposed Method

The benefits of this method are 1) Faster inspection process, 2) Rate of inspection up to a maximum 120 balls 3) minimum grading 4) automatic inspection 5) high accuracy due to high precision grounded shafts 6) employed gravitational force for inspection7) ball spins over the cylinders during inspection 8) Maximum Surface area are qualified for size (all the points of ball covered for inspection due to gravity movement and ball rotation by shafts) 9) instrument waiting time reduced due to calibration time avoided sss10) Productivity improved 11) ,Instrument cost and calibration cost avoided.12) operator fatigue minimized 13) good ergonomic conditions 14) mixing up of accepted and rejected balls avoided.

3. Analysis results

The measurements taken by the above method for 150 balls are shown in check list. Same balls Feeding to the machine through vibrator feeder. Balls run through the rotating shaft and collected in to the box which provided at the bottom of the shafts. Again take measurement of the balls from each box and verify. Balls segregated as per set value and found all the balls within specification.

Table 3: Inspected Balls summary Report

Si.no	Batch size	Size	Status	Remarks
1	Below 7.000	6.990	Not accepted	Under size
2	Below 7.000	6.995	Not accepted	Under size
3	Above 7.025	7.030	Not accepted	Over size
4	Above 7.025	7.028	Not accepted	Over size
5	Above 7.025	7.033	Not accepted	Over size
6	7.001 to 7.008	7.005	Accepted	-
7	7.001 to 7.008	7.004	Accepted	-
8	7.001 to 7.008	7.005	Accepted	-
9	7.001 to 7.008	7.004	Accepted	-
10	7.001 to 7.008	7.008	Accepted	-
11	7.001 to 7.008	7.003	Accepted	-
12	7.001 to 7.008	7.005	Accepted	-
13	7.001 to 7.008	7.004	Accepted	-
14	7.001 to 7.008	7.005	Accepted	-
15	7.001 to 7.008	7.003	Accepted	-
16	7.001 to 7.008	7.005	Accepted	-
17	7.001 to 7.008	7.007	Accepted	-
18	7.001 to 7.008	7.002	Accepted	-
19	7.001 to 7.008	7.004	Accepted	-
20	7.001 to 7.008	7.006	Accepted	-
21	7.001 to 7.008	7.007	Accepted	-
22	7.001 to 7.008	7.006	Accepted	-
23	7.001 to 7.008	7.005	Accepted	-
24	7.001 to 7.008	7.006	Accepted	-
25	7.001 to 7.008	7.006	Accepted	-
26	7.001 to 7.008	7.005	Accepted	-
27	7.001 to 7.008	7.004	Accepted	-
28	7.001 to 7.008	7.008	Accepted	-
29	7.001 to 7.008	7.003	Accepted	-
30	7.001 to 7.008	7.005	Accepted	-
31	7.001 to 7.008	7.004	Accepted	-
32	7.001 to 7.008	7.005	Accepted	-
33	7.001 to 7.008	7.007	Accepted	-
34	7.001 to 7.008	7.002	Accepted	-
35	7.001 to 7.008	7.004	Accepted	-
36	7.001 to 7.008	7.006	Accepted	-
37	7.001 to 7.008	7.007	Accepted	-
38	7.001 to 7.008	7.006	Accepted	-
39	7.001 to 7.008	7.006	Accepted	-
40	7.001 to 7.008	7.007	Accepted	-
41	7.001 to 7.008	7.007	Accepted	-
42	7.001 to 7.008	7.002	Accepted	-
43	7.001 to 7.008	7.004	Accepted	-
44	7.001 to 7.008	7.006	Accepted	-
45	7.001 to 7.008	7.007	Accepted	-
46	7.001 to 7.008	7.006	Accepted	-
47	7.001 to 7.008	7.005	Accepted	-
48	7.001 to 7.008	7.003	Accepted	-
49	7.001 to 7.008	7.004	Accepted	-
50	7.009 to 7.018	7.013	Accepted	-
51	7.009 to 7.018	7.015	Accepted	-
52	7.009 to 7.018	7.017	Accepted	-
53	7.009 to 7.018	7.010	Accepted	-
54	7.009 to 7.018	7.012	Accepted	-
55	7.009 to 7.018	7.014	Accepted	-
56	7.009 to 7.018	7.016	Accepted	-
57	7.009 to 7.018	7.018	Accepted	-
58	7.009 to 7.018	7.017	Accepted	-
59	7.009 to 7.018	7.015	Accepted	-
60	7.009 to 7.018	7.013	Accepted	-
61	7.009 to 7.018	7.011	Accepted	-
62	7.009 to 7.018	7.014	Accepted	-
63	7.009 to 7.018	7.017	Accepted	-
64	7.009 to 7.018	7.015	Accepted	-
65	7.009 to 7.018	7.014	Accepted	-
66	7.009 to 7.018	7.017	Accepted	-
67	7.009 to 7.018	7.016	Accepted	-
68	7.009 to 7.018	7.015	Accepted	-
69	7.009 to 7.018	7.013	Accepted	-
70	7.009 to 7.018	7.015	Accepted	-
71	7.009 to 7.018	7.014	Accepted	-
72	7.009 to 7.018	7.015	Accepted	-
73	7.009 to 7.018	7.015	Accepted	-
74	7.009 to 7.018	7.014	Accepted	-
75	7.009 to 7.018	7.015	Accepted	-
76	7.009 to 7.018	7.017	Accepted	-
77	7.009 to 7.018	7.015	Accepted	-
78	7.009 to 7.018	7.014	Accepted	-
79	7.009 to 7.018	7.017	Accepted	-
80	7.009 to 7.018	7.016	Accepted	-
81	7.009 to 7.018	7.015	Accepted	-
82	7.009 to 7.018	7.013	Accepted	-
83	7.009 to 7.018	7.015	Accepted	-
84	7.009 to 7.018	7.014	Accepted	-
85	7.009 to 7.018	7.015	Accepted	-
86	7.009 to 7.018	7.015	Accepted	-
87	7.009 to 7.018	7.013	Accepted	-
88	7.009 to 7.018	7.015	Accepted	-
89	7.009 to 7.018	7.017	Accepted	-
90	7.009 to 7.018	7.010	Accepted	-
91	7.009 to 7.018	7.012	Accepted	-
92	7.009 to 7.018	7.014	Accepted	-
93	7.009 to 7.018	7.016	Accepted	-
94	7.009 to 7.018	7.018	Accepted	-
95	7.009 to 7.018	7.017	Accepted	-

96	7.009 to 7.018	7.015	Accepted	-
97	7.009 to 7.018	7.013	Accepted	-
98	7.009 to 7.018	7.011	Accepted	-
99	7.009 to 7.018	7.014	Accepted	-
100	7.009 to 7.018	7.017	Accepted	-
101	7.009 to 7.018	7.015	Accepted	-
102	7.009 to 7.018	7.014	Accepted	-
103	7.009 to 7.018	7.017	Accepted	-
104	7.009 to 7.018	7.016	Accepted	-
105	7.009 to 7.018	7.015	Accepted	-
106	7.009 to 7.018	7.013	Accepted	-
107	7.009 to 7.018	7.015	Accepted	-
108	7.009 to 7.018	7.014	Accepted	-
109	7.009 to 7.018	7.015	Accepted	-
110	7.009 to 7.018	7.013	Accepted	-
111	7.009 to 7.018	7.015	Accepted	-
112	7.009 to 7.018	7.017	Accepted	-
113	7.009 to 7.018	7.010	Accepted	-
114	7.009 to 7.018	7.012	Accepted	-
115	7.009 to 7.018	7.014	Accepted	-
116	7.009 to 7.018	7.016	Accepted	-
117	7.009 to 7.018	7.018	Accepted	-
118	7.009 to 7.018	7.017	Accepted	-
119	7.009 to 7.018	7.015	Accepted	-
120	7.009 to 7.018	7.013	Accepted	-
121	7.009 to 7.018	7.011	Accepted	-
122	7.009 to 7.018	7.014	Accepted	-
123	7.009 to 7.018	7.017	Accepted	-
124	7.009 to 7.018	7.015	Accepted	-
125	7.019 to 7.025	7.023	Accepted	-
126	7.019 to 7.025	7.022	Accepted	-
127	7.019 to 7.025	7.025	Accepted	-
128	7.019 to 7.025	7.023	Accepted	-
129	7.019 to 7.025	7.022	Accepted	-
130	7.019 to 7.025	7.021	Accepted	-
131	7.019 to 7.025	7.024	Accepted	-
132	7.019 to 7.025	7.020	Accepted	-
133	7.019 to 7.025	7.023	Accepted	-
134	7.019 to 7.025	7.022	Accepted	-
135	7.019 to 7.025	7.025	Accepted	-
136	7.019 to 7.025	7.023	Accepted	-
137	7.019 to 7.025	7.022	Accepted	-
138	7.019 to 7.025	7.021	Accepted	-
139	7.019 to 7.025	7.024	Accepted	-
140	7.019 to 7.025	7.020	Accepted	-
141	7.019 to 7.025	7.025	Accepted	-
142	7.019 to 7.025	7.023	Accepted	-
143	7.019 to 7.025	7.022	Accepted	-
144	7.019 to 7.025	7.021	Accepted	-
145	7.019 to 7.025	7.024	Accepted	-
146	7.019 to 7.025	7.020	Accepted	-
147	7.019 to 7.025	7.023	Accepted	-
148	7.019 to 7.025	7.020	Accepted	-
149	7.019 to 7.025	7.025	Accepted	-
150	7.019 to 7.025	7.023	Accepted	-

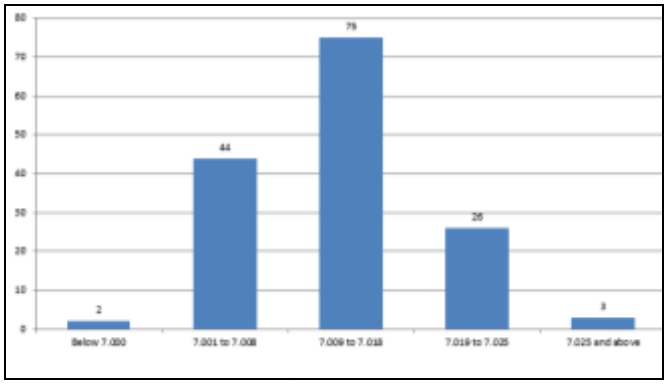

Fig. 5: Shaft Taper setting Pins

4. Conclusion:

The final conclusion is the performance of the Machine can be measured and compared with Digital Micro meter inspection and found accepted. Ball segregated by the machine and again inspected by the operators. Repeatability and Reproducibility checked and found accepted. Thus the benefits of incorporating this machine are summarized as: Reduced measurement errors. Ensuring that no defective piece is cleared for production and vice versa. Saves time taken to re-check or repeat measurements. Instrumental errors are nullified, Reduces the measurement time, Measurement time is significantly reduced by measuring the ball with vibrator feeding automatic Ball inspection machine compared to measurement with digital micrometer and No skilled operator is required. In the case of digital micrometer, a highly skilled operator is required to minimize parallax and instrumentation errors. Hence no special training or experience is required to operate this machine. Operator fatigue is reduced. Continuous measurement gives strain to the eyes of the operator, affecting his concentration. This will lead to measurement errors. By using vibrator feeding automatic Ball inspection machine, the operator fatigue is significantly reduced. The final conclusion is the performance of the Machine can be measured and compared with Digital Micro meter inspection and found accepted. Ball segregated by the machine and again inspected by the operators. Repeatability and Reproducibility checked and found accepted.

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