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Testing of Multi-utility zero slip gripper system by application of mating worm system

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Abstract— *M/s Anil Industries 35/6 MIDC ROAD, Morwadi, Pimpri, Pune is a Small scale manufacturing industry which supplies parts to Chemical industry, Material handling equipment manufacturing industry. A vertical machining centre require to handle heavy job up to 90-100 kg maximum, presently the loading of work-pieces is done manually using chain blocks , which requires two or more labour to handle the system. This method is time consuming, unsafe .there was a need to develop device for easy clamping & de-clamping with zero slip. This paper describes experimental testing of a prototype Multi-utility zero slip gripper system to be operated using 12 Volt DC power. The proposed model is to be developed to demonstrate the clamping & de-clamping with zero slip ability.*

Keywords: Gripper, Zero slip, Worm, Self-locking, Multi-utility

1. INTRODUCTION

The term zero slip gripper system is applied to a modified work handling device in the form of jaw capable to handle heavy pipes as well as plates with equal efficiency. The jaw system incorporates a twin worm drive that is simply constructed. Two threaded rods, or "worm" screws, are meshed together. Each worm is wound in a different direction and has a different pitch angle. For proper mesh, the worm axes are not parallel, but slightly skewed. But by selecting proper, and different, pitch angles, the drive will exhibit either self-locking

Fig -1: Work-piece loading.

1.1 Problem statement at Company End

M/s Anil Industries 35/6 MIDC ROAD, Morwadi, Pimpri, Pune -18 It is a Small scale manufacturing industry which supplies parts to Chemical industry, Material handling equipment manufacturing industry. A vertical machining centre require to handle heavy job up to 90-100 kg maximum, presently the loading of work-pieces is done manually using chain blocks , which requires two or more labour to handle the system. This method is time consuming, unsafe .there was a need of a modified work handling device in the form of jaw capable to handle pipes as well as plates with equal efficiency.

Problem in hand is to develop a device to be operated using 12 Volt DC power, system to be button operated with easy clamp ing and de-clamping facility so that operator can single handed load or unload the work-piece onto machine. The proposed model is to be developed to demonstrate the work-piece clamping system, and self locking ability. The PMDC motor is to be used to demonstrate the gripping force produced by the jaw set.

1.2 Solution in our project

The force applied to the jaw gripper comes through a set of self locking screws hence only when the tie rod lever when rotated anti-clockwise with purpose loosen the job will the job loosen but the job on its own cannot slip as the tendency to slip will result in an resultant clamping force due to the self locking screw mechanism, hence the design of the zero-slip gripper is fool proof and secure as compared to the earlier device mentioned above resulting in maximum safety of work-piece / property or human life.

2. WORKING

The 2-pole 2-way switch of the circuit controls the direction of the motor , where as the push button controls as to time for which the motor remains 'on'. The motor rotate the pinion and gear arrangement that makes the nut to rotate in ball bearing. The rotation of the nut makes the screw to translate in forward direction which makes the input worm to rotate the output worm. The output shaft rotates as the output worm is fixed on to it, the movable jaw comes down to effect the clamping action. Thus the clamping action is achieved, but the reversal of the jaw is not possible due to self locking action.

In order to de-clamp the work-piece the 2-pole 2-way switch this reverses the direction of rotation of motor and thus the nut rotates to reverse the direction of screw translation. The screw moves backward to rotate the input load arm to reverse the direction of the input worm and thereby the output worm rotates to move the movable jaw to de-clamp the work piece.

3. TEST & TRIAL

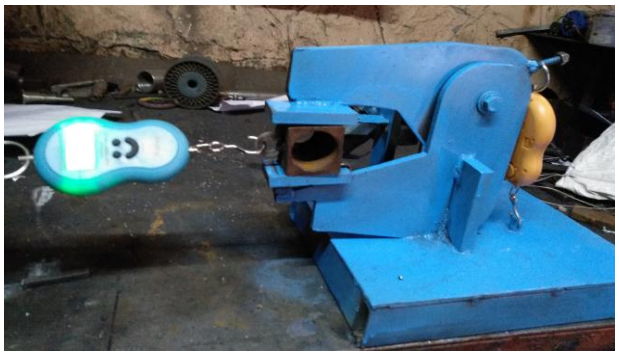


Fig -2: Experimental Set up.

The trial is conducted in order to test the following characteristic of the lifting device which are as follows,

A. Gripping force Vs Angle of arm travel

B. Self locking Vs. Angle of arm travel

C. Comparative Graph

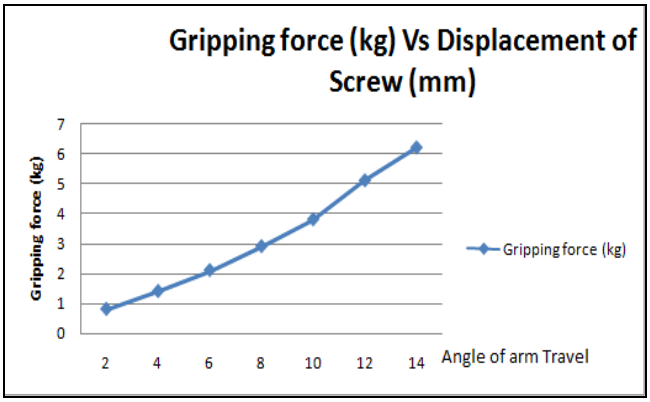
3.1 PROCEDURE OF TRIAL

1. Place work piece in the jaw system
2. Start motor to move the jaw system
3. Take reading on load meter. note the displacement of screw for reference comparison
4. Apply force on the work piece using spring balance note force up to which the job slips from the jaw
5. Repeat readings
6. Note the maximum load application ability & maximum zero-slip load

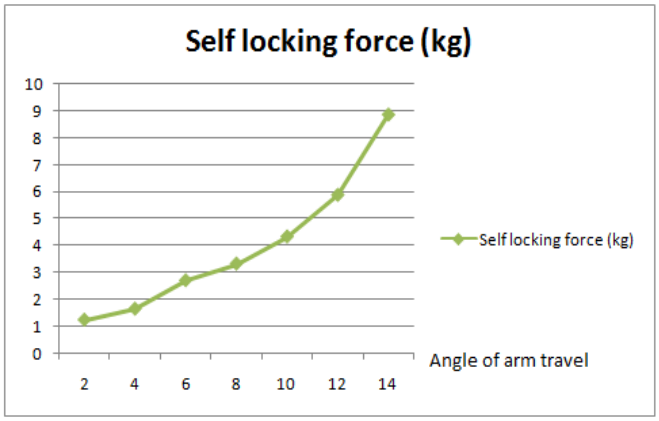
3.2 OBSERVATION TABLE

Angle of Arm travel	Load meter reading (gripping force)kg	Spring balance reading (self locking load)	Slip
02	0.8	1.24	0
04	1.4	1.65	0
06	2.1	2.71	0
08	2.9	3.33	0
10	3.8	4.34	0
12	5.1	5.89	0
14	6.2	8.88	0

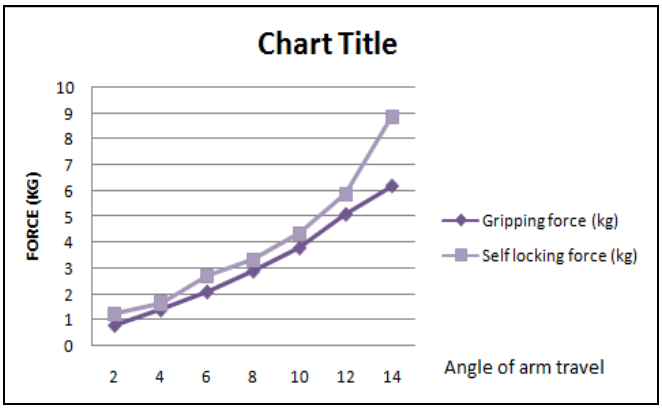
GRAPH - Gripping force Vs Angle of arm travel



GRAPH - Self locking Vs. Angle of arm travel



GRAPH - Comparative



4. CONCLUSION

1. Gripping force increases with the increase in angle of arm travel thus securely clamping the work-piece / job / object
2. Self-locking force increases with the increase in angle of arm travel thus securely clamping the work-piece / job / object and eliminating the possibility of job under self-weight as the self-locking force is greater the gripping force.

3. The self-locking force well exceeds the gripping force applied at all points thereby confirming that the gripper functions to 100% efficiency at all points or displacement of screw thereby ensuring

4. The job once clamped will not be released by its self-weight un-less unit the jaw releases it.

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