ENDURANCE TESTING MACHINE FOR NONAUTOMATIC WEIGHING INSTRUMENTS

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ABSTRACT

A machine was designed and manufactured for endurance tests of nonautomatic weighing instruments according to the regulation of OIML R76-1-2 and EEC/90/384. An AC servomotor directly actuates the machine. It has also control panel and software. It has a compact module consisting of ball screw mechanism and a handler, made of polyamide material, specially designed. It is used for handling nine numbers of standard masses, knops headed type, with ranges 100 g up to 50 kg. There are nine types of weight carriers for each different mass. Some parameters for loading and unloading of masses can be set to desired values within limits by using control panel. The velocities of loading and unloading of masses and also standing time of mass on the instrument can be adjusted. All parts of movable section of the machine were enclosed by using plexiglas material for preventing. The machine is capable of 100.000 and more times fully automatically loading and unloading of 9 (nine) types of standard masses on to the instrument. It can also be modified to another standard masses not in range 100 g to 50 kg.

1. INTRODUCTION

The machine was designed for purpose of repetitive loading and unloading of standard masses to the weighing instruments according to the regulation of OIML R76/1-2 and EEC/90-384 [1-2]. Non-automatic weighing instrument (Class I, II and III with maximum capacity is equal or less than 100 kg) must be tested for approving. 100.000 times is required for the regulation. It is very difficult for performing manually. In designed machine, the number of repetition is 100000 times and more if desired. The machine is capable of automatically loading and unloading various masses (maximum 50 kg to minimum 100 g). It has ball screw (Ball Bearing Screw) mechanism with servomotor and its motion controller as a drive unit. All parts in the machine can be replaceable and changeable. Movable parts of the machine are closed using plexiglas material (marked as FG in Figure 1).

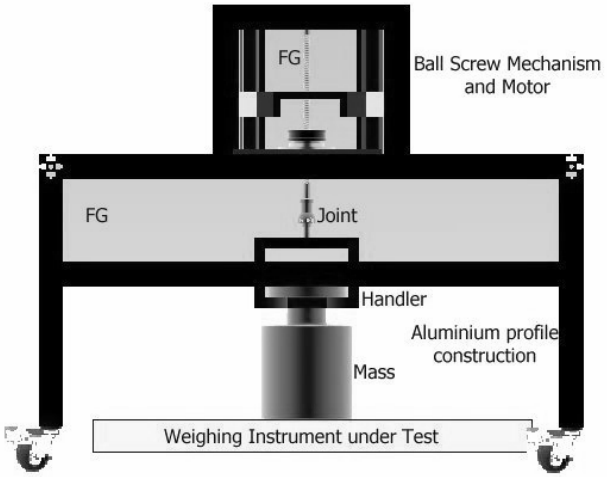

Figure 1: General view of the machine (Schematically) (FG: Plexiglas)

2. MACHINE

2.1 General Descriptions of the Machine and Main Body

Aluminium profile construction was preferred in the machine main body (Figure 2). Aluminium profile parts were supported to the machine and other parts. These elements are very suitable for design, assembling and lifetime of machine. Also other supporting elements in assembling were used. These parts are with drawn to maximum load of machine when it works. Selected parts are suitable for transportable machine. Repetitive loading and unloading are considered for design (for fatigue failure) and selection. Profile selection was done considering the maximum load, repetitive loading and lifetime of the machine. The machine is suitable to place on various weighing instruments specified dimensions. The mass can be placed on the centre of the instruments' upper side. The machine can be movable using wheel (min. 4 wheels) and they can be locked completely [3].

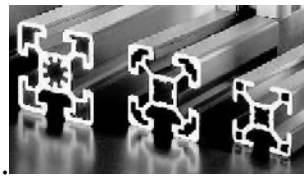

Figure 2: Section view of the profile used in the machine main body

2.2 Drive Mechanism, Ball Screw and Compact Module

There are several methods to lift masses and set on the instrument. Because of effective cost, easily workable and simply manufacturing, the machine is motorized and driven by using servomotor and ball screw mechanism. A motor with flange, coupling, brake and its motion control unit (AC Servomotor, power of 1.5 kW, 3800 rpm) were selected for sensitive loading and unloading on the instrument. Compact module was used for ball screw and for its guideways. Screw bearings were selected considering axial and radial forces acting on it.

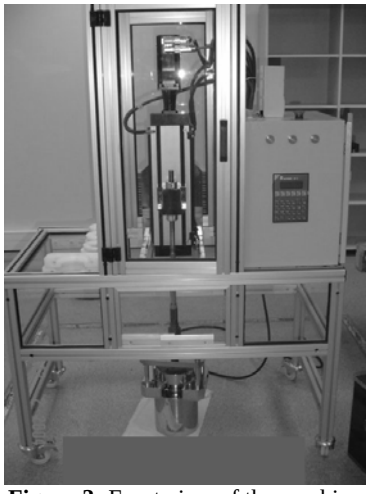

Figure 3: Front view of the machine

A significant reduction in thread friction is archived using ball screw, which use a train of ball bearing in the nut to create an approximate rolling contact with screw threads as show in Figure

3. The low friction of ball screw makes it back-driven by a ball screw. So, when it uses in vertical application brake must be attached to the motor to prevent falling down [4].

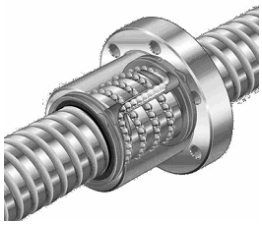

Figure 3: Ball screw mechanism

Compact module involves ball screw, shaft and linear guideways. It is complete solution for linear motion and application. The compact module is shown in Figure 4.

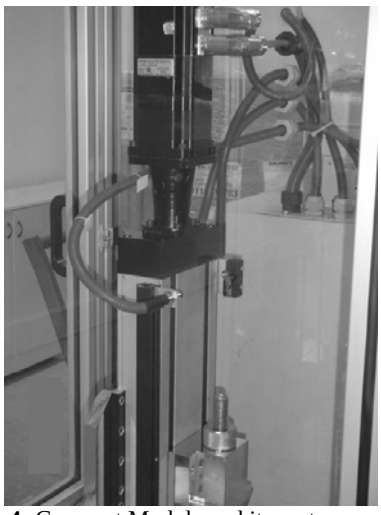

Figure 4: Compact Module and its motor connection

3. MASS HANDLER DESIGN

Handler was designed for handling of the standard masses (100 g to 50 kg, 9 types of different weights). Loading and unloading are done by means of handling the knops headed part of the mass. The material is polyamide (Monolithic design) so direct metal contact prevented surfaces between standard masses and handler. Design was done considering the load, fatigue and other common failure criteria. It was connected to the ball screw mechanism using a joint, which was used for centring loads along vertical axis. The handler and its 50 kg apparatus assembly are shown in figure 5, other different mass parts shown in figure 6.

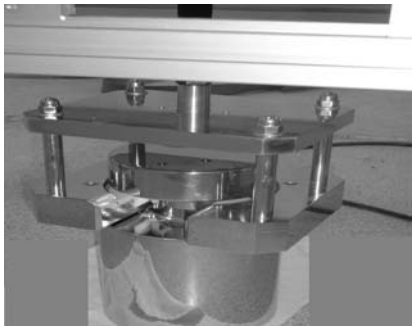

Figure 5: Handler, joint and mass connection

Figure 6: Mass Handling Parts

4. CONTROL UNIT AND SOFTWARE

The machine has own control panel with display and CAN OPEN communication. Driver can be controlled and monitored. Manual control of the motor can be available via control panel. Sensitive loading of the mass: Speed of loading and unloading can be set to desired value. Parameters such as frequency (number of repetition), period (standing time of the load on the instruments) and speed of the screw at various positions can be set via control panel manually or RS 232 communication protocol. Number of repetition in progress can be seen on display. Loading, unloading (time and speed) and number of cycle can be programmable.

5. CONCLUSION

A special endurance testing machine was designed and manufactured. The performance tests showed that this machine was suitable for loading and unloading application in mass metrology. Also various masses adapted to the same handler using additional parts.

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