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Methods of Protection against Vibration of Technological Machines in Sewing Production

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ABSTRACT: This article has eliminated the directions and ways of protection against vibration of technological machines of sewing production are given in article. Vibration isolation is a reduction in the vibration level of a protected object by reducing the transmission of vibrations to this object from the vibration source. Vibration isolation is carried out by introducing an additional elastic connection into the oscillatory system, which prevents the transmission of vibrations from the machine - the source of vibration - to the base or adjacent structural elements; this elastic connection can also be used to attenuate the transmission of vibrations from the base to the person or to the unit to be protected.

KEYWORDS: vibroprotection, vibrodamping, vibroclearing, vibration insulation, operation of the technique, vibration amplitude of machine parts, the elimination of vibrations, vibration reduction.

I.INTRODUCTION

To prevent the harmful effects of vibration on the human body, a complex of technical and organizational measures is provided. Technological ways and means of dealing with vibration are varied. The weakening of vibration at the source of its occurrence is achieved by improving the design of equipment, kinematic schemes, replacing dynamic processes with static ones, replacing the shock action of machines and mechanisms with rotational ones, careful balancing of rotating parts

The technical measures include the elimination of vibrations in the source and along the path of their propagation. To reduce vibration in the source at the design and manufacturing stage of machines, favorable vibration working conditions are provided. Replacement of shock processes with non-shock ones, the use of plastic parts, belt drives instead of chain drives, the choice of optimal operating modes, balancing, improving the accuracy and quality of processing lead to a decrease in vibrations [1].

II. SIGNIFICANCE OF THE SYSTEM

During the operation of the technique, vibration reduction can be achieved by timely tightening of fasteners, elimination of backlash, gaps, high-quality lubrication of rubbing surfaces and adjustment of working bodies.
To reduce vibrations along the propagation path, vibration damping, vibration damping, vibration isolation are used.

Vibration damping is a decrease in the vibration amplitude of machine parts (casings, seats, foot pads) due to the application of a layer of viscoelastic materials (rubber, plastics, etc.) on them. The thickness of the damping layer is usually 2 ... 3 times the thickness of the structural element on which it is applied.

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III. LITERATURE SURVEY

Vibration damping can be carried out using two-layer materials: steel-aluminum, steel-copper.

Vibration damping is achieved by increasing the mass of the vibrating unit by installing it on solid massive foundations or slabs, as well as by increasing the rigidity of the structure by introducing additional stiffeners into it.

One of the ways to suppress vibrations is the installation of dynamic vibration dampers that are mounted on a vibrating unit, therefore, vibrations that are in antiphase with the vibrations of the unit are excited in it at each moment of time.

The disadvantage of a dynamic vibration damper is its ability to suppress vibrations of only a certain frequency (corresponding to its own).

IV. METHODOLOGY

Vibration isolation is a reduction in the vibration level of a protected object by reducing the transmission of vibrations to this object from the vibration source. Vibration isolation is carried out by introducing an additional elastic connection into the oscillatory system, which prevents the transmission of vibrations from the machine - the source of vibration - to the base or adjacent structural elements; this elastic connection can also be used to attenuate the transmission of vibrations from the base to the person or to the unit to be protected. Vibration isolation is achieved by installing the units on special elastic devices (supports) with low rigidity. The effectiveness of vibration isolation is estimated by the transmission coefficient, which has the physical meaning of the ratio of the force acting on the base in the presence of an elastic connection to the force acting on a rigid connection. The smaller this ratio, the better the vibration isolation. Good vibration isolation is achieved at KP = 1 / 8-1 / 15.

With an increase in operating speeds, the level of noise and vibration of individual mechanisms and the machine as a whole increases, and accompanying effects arise that affect the quality of the technological operation performed. Eliminating these phenomena requires an in-depth study of the dynamics of sewing machines, which would make it possible to evaluate the effectiveness of various methods of reducing vibration and noise at the design stage. An important issue is also the study of possible design options for mechanisms from the standpoint of improving the quality of technological operations on high-speed sewing machines.

Despite the wide variety of sewing machines, there is an urgent need to develop new, more advanced, modernization of the existing fleet of machines. When creating new and modernizing existing sewing machines, solving the problems of kinematic and dynamic analysis of their units is of great importance. The solution of these problems leads to a significant reduction in the time required for the design, manufacture, fine-tuning and introduction of machines into operation.

The main sources of noise and vibration in the sewing industry are dynamic loads in gears resulting from certain errors in their manufacture; variability of the load perceived by balls or rollers in rolling bearings; dynamic impacts of balls or rollers on the uneven surface of the raceways of the outer and inner rings of bearings, etc.

Consequently, the main ways to reduce vibrations and noise of sewing machines are the use of high-quality bearings, low-noise gears and electric motors, adherence to technological discipline in the manufacture and assembly of units, the use of rational structures and devices, the rigidity of their fastening.

V. EXPERIMENTAL RESULTS

The main areas of protection against vibration:

1. The fight against vibration at the source of its origin involves the design and design of such machines and technological processes in which unbalanced forces are excluded or reduced, there is no shock interaction of parts, and sleeve bearings are used instead of rolling bearings. The use of special types of engagement and cleanliness of the surface of the gears can reduce the vibration level by 3-4 dB. Elimination of the imbalance of the rotating masses is achieved by balancing.

2. Detuning from the resonance mode is achieved either by changing the characteristics of the system (mass and stiffness), or by changing the angular velocity. The stiffness characteristics of the system are changed by introducing stiffening ribs into the structure or by changing its elastic characteristics.

3. Vibration damping is a decrease in the vibration of an object by converting its energy into other types (ultimately, into heat energy). An increase in energy losses can be achieved by different methods: using materials with high internal friction; the use of plastics, wood, rubber; application of a layer of elastic-viscous materials with large

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losses on internal friction (roofing material, foil, mastics, plastic materials, etc.). The thickness of the coatings is taken equal to 2-3 thicknesses of the damped structural element. Lubricating oils damp vibrations well.

4. Vibration damping is a way to reduce vibration by introducing additional reactive impedances (resistances) into the system. Most often, for this, vibrating units are installed on massive foundations.

5. Vibration isolation is a way to reduce vibration of a protected object by introducing an elastic connection into the system, which prevents the transmission of vibration from the vibration source to the base or adjacent structural elements.

Anti-vibration elements can be presented:

a) in the form of separate supports: spring vibration isolators, the main working element of which is one or more steel coil springs; elastic gaskets, often having a complex shape;

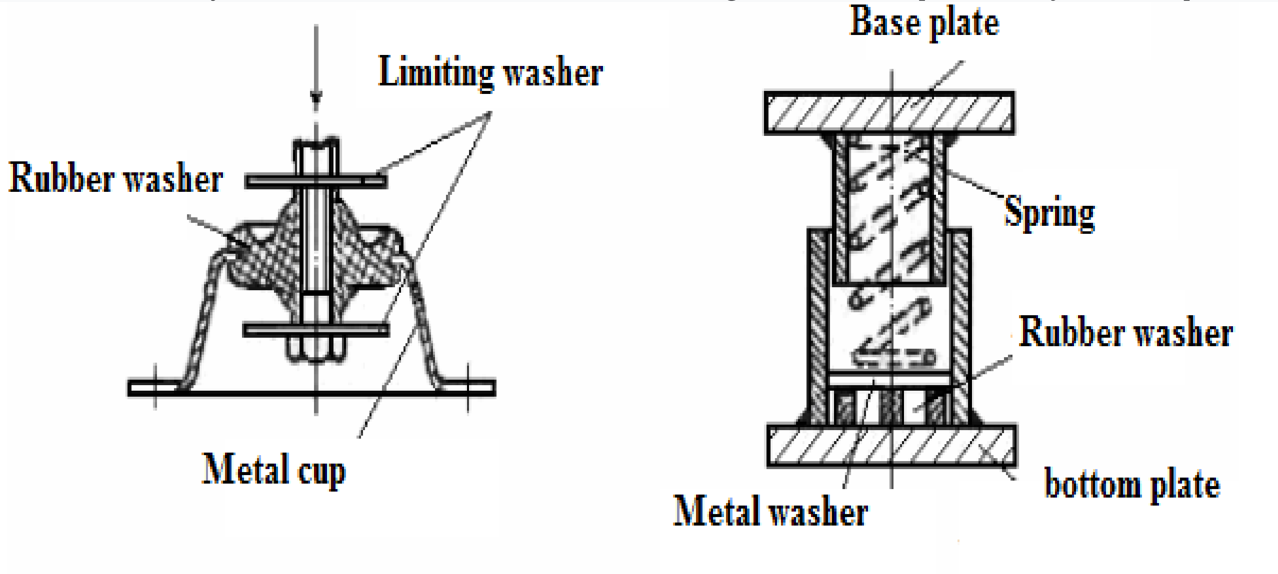
b) in the form of a layer of elastic material laid between the machine and the foundation;

For vibration isolation of vibration excitation sources, use: a) spring, spring-rubber and rubber-metal vibration isolators (Fig. 1); b) elastic rubber gaskets; c) combined vibration isolators (installation of vibration isolators on gaskets made of elastic materials such as rubber).

For effective vibration isolation, the foundation on which the equipment is mounted on vibration isolators must have a large mass. When insulating with the help of spring dampers and elastic gaskets, vibrational energy is reflected to a greater extent and energy is absorbed to a lesser extent in the insulating elements themselves [2].

Fig. 1. a) spring, spring-rubber and rubber-metal vibration isolators

Vibration protection with massive elements is ineffective for low frequencies. In such cases, active (control) vibration isolation systems are used. In them, external forces causing vibration of the protected object are compensated



by an additional source of energy. Active vibration isolation systems are used to protect precision machine tools, launch platforms, pilots from overloading and improve vehicle comfort. The active system contains sensitive elements (sensors), devices for creating a control action.

Depending on the requirements, amplifying and actuating devices can be hydraulic, pneumatic, electromechanical, electromagnetic. In fig. 1 shows a diagram of active vibration protection, where active feedback is introduced, which forms a control action *V (t).*

The purpose of vibration protection is to reduce the vibrations of an object with a mass *M* under a kinematic disturbance ξ *(t).* The control action *V (t)* is applied to the intermediate mass m. Management can be carried out:

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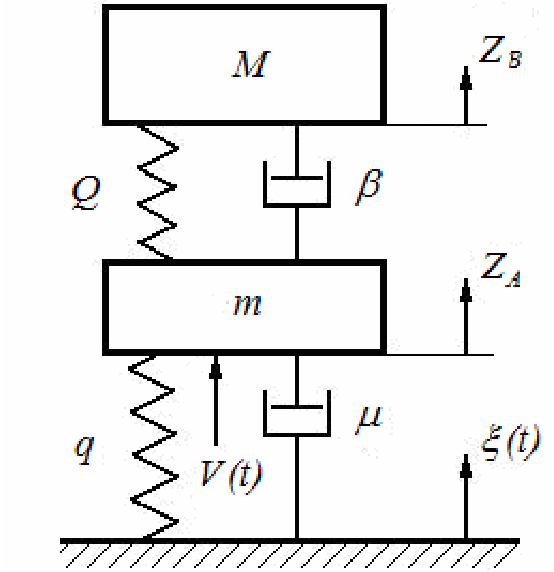

Fig. 2. Active vibration protection circuit

1. In relation to the masses *M* and *m*. Then the control action is carried out by moving the mass M in the direction *ZB*:

$$B\ V = -k \cdot W(P) \cdot Z\ , (1)$$

where k is the gain; *W (P)* - transfer function of the chain including the sensor and the actuator or control action

$A\ V = -k \cdot W(P) \cdot Z$ for the mass *m*.

2. By disturbance ξ (t), where the control action:

$$V = -(\mu \cdot P + q) \cdot \xi(t) \text{ или } V = W(P) \cdot \xi(t).\ (2)$$

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