TENSIONING AND GUIDING SYSTEMS USED IN CHAIN DRIVES

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Keywords: chain, camshaft, dry shaft, guiding system, tensioning system, hydraulic tensioning.

Abstract: The paper presents the chain transmission components for an automobile engine. A brief presentation of the existing constructive solutions for the tensioning and chain guiding in an internal combustion engine transmission is made. Based on the study of existing patents on improvement of tensioning and guiding systems, a series of relevant and constructive solutions have been identified, in which there were considered the following criteria: functioning of chain guide system; constructive principle of chain guide system; long-term effects of chain guide system.

1. INTRODUCTION

A chain guide system must provide the possibility of adjusting the tensioning chain because after the inevitable wear of the joint the chain lengthens. The tensioning system must be able to compensate for stretching the limits of two steps and the result is the removal of two links of chain [1, 2, 3, 4, 5, 6].

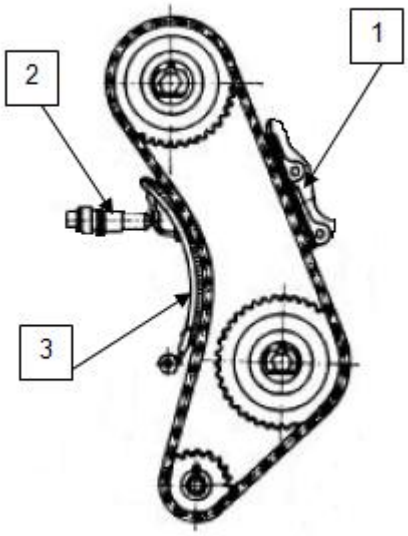


Fig. 1 Chain drive system: 1 - chain guide; 2- hydraulic actuator; 3 – sabot

This paper creates a data base of pre-tensioning systems solutions and, also, of the chain guide system, in a whole combustion engine. Each element of the chain drive system is presented with its role and functionality.

2. COMPARATIVE ANALYSIS OF TENSIONING AND GUIDING SOLUTIONS

According to the technical literature [2], a series of relevant and constructive solutions have been identified, in which there were considered the following criteria:

- The functioning method of chain guide system;
- The constructive principle of chain guide system;
- The long-term effects of chain guide system.

This criteria relates how to improve a sliding member for a chain system, a chain guide, a chain tensioner and a chain system, more specifically to a sliding member formed

of a resin composition and to be applied to a chain system, and a chain guide, a chain tensioner and a chain system which use the sliding member.

Table 1 synthesizes the main new patented solutions of tensioning and guiding systems used in the chain drive systems depending on the component to which they reefer and presents their main characteristics according to the previous criteria.

Table 1. Solutions of tensioning and guiding systems

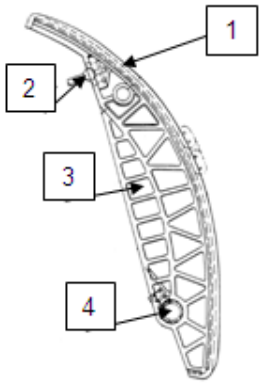
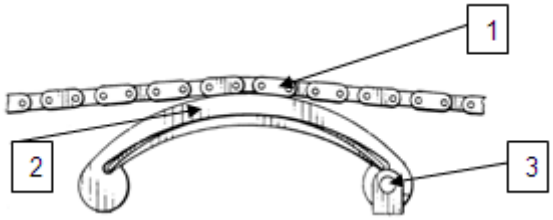
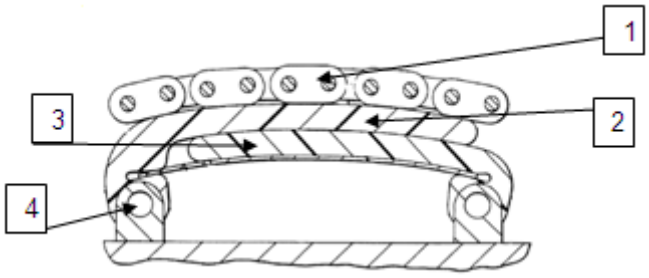
A. Chain guiding mechanism [7]	
	1 – guiding element; 2 – tensioning piston; 3 – inferior element of the guide; 4 – gripping holes. **Advantages:** • easy assembly. **Disadvantages:** • complex manufacturing process; the assembly is made by welding which leads to reduced strength.
B. Tensioning chain guide [8]	
	1 - chain; 2 - guiding element; 3 - inferior element of the guide **Advantages:** • trough this configuration, the spring is mechanically connected with the templates, the guiding element fixing not being needed. **Disadvantages:** • the spring creates a tension in the sabot making it to deform, therefore creating tension in the chain.
C. Chain tensioning system [9]	
	1- chain; 2 - guiding element; 3 - inferior element of the guide; 4 - gripping holes. **Advantages:** • it increases the force of the engine; • the tension is applied in one point and it is distributed on a large surface. **Disadvantages:** • using an hydraulic actuator each chain can be worn-out at different time intervals; • un-controllable wear.

Table 1. Solutions of tensioning and guiding systems (continued)

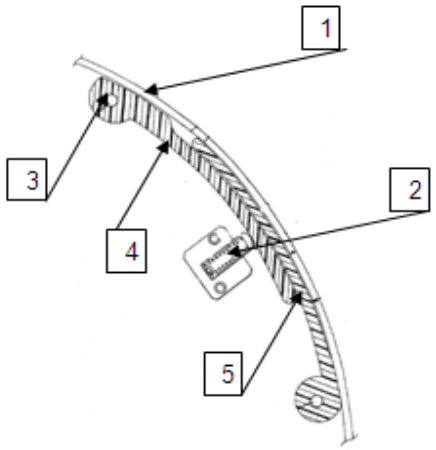
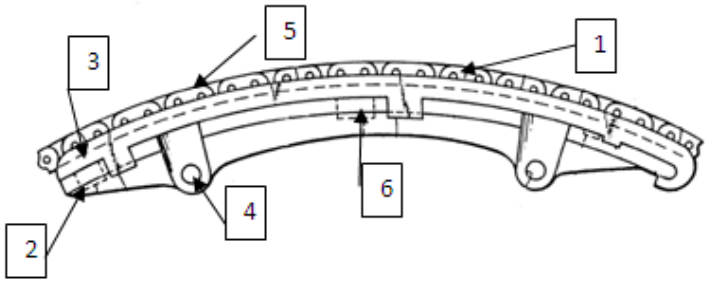
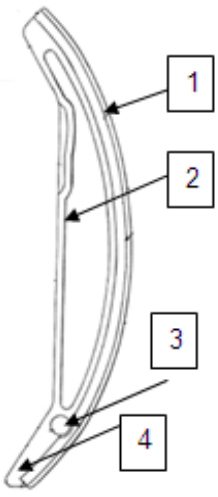
D. Tensioning system [10]	
	1- guiding element; 2- hydraulic actuator; 3 - gripping holes; 4 – inferior dual element; 5 - superior dual element **Advantages:** • Each pivot is supported in two points: the pivoting point and the counter pivot, that applies a force on the ends of the dual arms; • the tension is applied in a point and it is distributed on a large surface. **Disadvantages:** • the occurrence of vibration between the two arms and the appearance of elements of secondary factor that results in the vibration on the contact surface.
E. Chain guiding system [11]	
	1- chain; 2- element; 3 – plastic retainer; 4 - gripping holes; 5 – side wall; 6 – fixing parts. **Advantages:** • the contact surface is greater resulting in a more efficient functioning of the engine. **Desadvanteges:** • the posible elongation of the skid due to the heat can appear; • because the internal temperature of the engine can get to 120 degrees exfoliations or wear of the skid can appear.
F. Guidance trail for chains [12]	
	1- sliding guide; 2 - clamp bracket; 3 - engine mounting point; 4 - pivot. **Advantages:** • the coating guidence element for the main body is made by extrudation • the clamp and the guidence skid have complementary profiles **Disadvantages:** • a reduced efficiency for the powerful engines.

Table 1. Solutions of tensioning and guiding systems (continued)

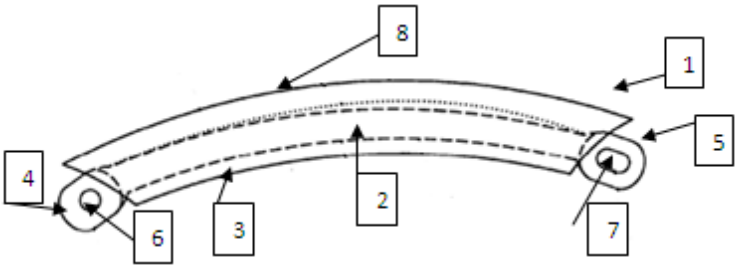
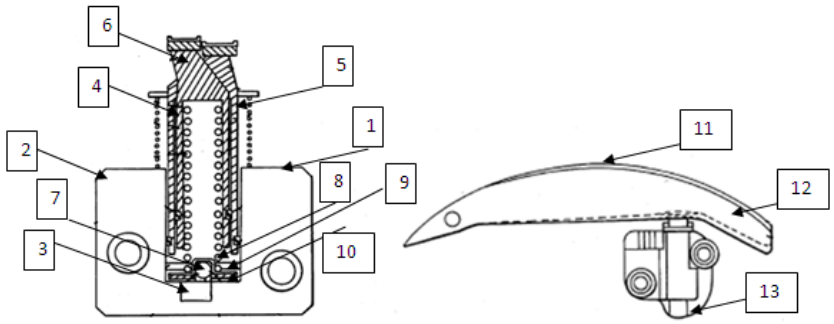
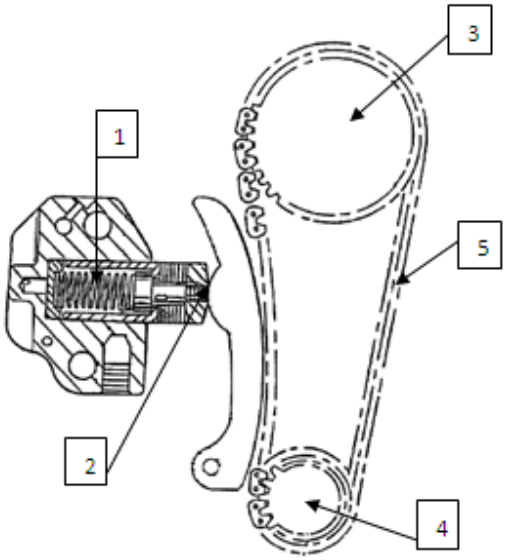
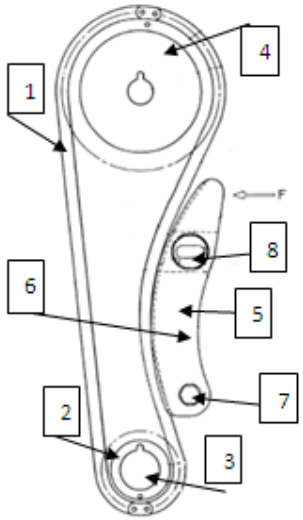
G. Chain guide [13]	
	1- guiding side view; 2 – guiding core; 3 – contact element; 4, 5 - peripheral gripping elements; 6, 7 - gripping holes **Advantages:** • a simple mounting and installation mechanism • the rigid core maintains the exterior contact form better them the once made of plastic material. **Disadvantages:** • it can not be mounted on the more powerful engines.
H. Hydraulic actuator [14]	
	1- hydraulic actuator; 2 – housing; 3 – gutter; 4 - intern piston; 5 - external piston; 6- upper end of piston; 7- check valve; 8 - pressurized fluid chamber; 9 - ball; 10 – spring; 11- superior element; 12-guiding element; 13 – hydraulic stretcher. **Advantages:** • Each piston is powered by the same oil pressure. **Disadvantages:** • The price is high in order to manufacture the whole assembly.
I. Hydraulic chain tensioning [15]	
	1 – piston 1; 2 – piston 2; 3 – cam shaft; 4 - crank shaft; 5- chain. **Advantages:** • the pretensioning system has the role to decrease the forces that appear during the functioning, the hydraulically disposal pressure system acts temporary only when the pressure exceeds the maximum limit. **Disadvantages:** • the complicate design of the parts • the high manufacturing cost.

Table 1. Solutions of tensioning and guiding systems (continued)

J. Chain guide joint [16]	
	1 - chain; 2- driving wheel, 3.4- chain wheels, 5 - elongated body; 6 – chain guiding; 7-guiding shaft; 8 - guiding collar. **Advantages:** • the simplicity of the system **Disadvantages:** • the skid is built in a chain drive that has no tensioner on the opposite side.

The solution presented in Table 1, A [7] represents a guide mechanism for a chain drive. Each component is made out of plastic. The components are injected in moulds or casted. This chain guide is used in an internal combustion engine. This tensioner can interact with the chain with the help of an hydraulic actuator which ensures a tension to the whole transmission system and can vary between certain parameters.

The solution of Table 1 B [8] presents the life of a tensioning chain constructed with a plastic sabot and a metal spring. This chain guide maintains the tension constant in the chain without the possibility of variations. Beside the precedent case, the system that incorporates this chain guide is always submitted to the same force and the wear effect in chain appears spontaneously.

The solution presented in Table 1, C [9] is a connection from the crankshaft and the camshaft of an engine can use two different chains. This chain guide acts with a force given by a typical actuator, in two parallel chains. The tension on the two strands is variable.

The solution presented in Table 1, D [10] represents a tensioning system having a dual arm and a hydraulic actuator. d. This chain guide with double arms has a hydraulic system for tensioning and is used at "V" motors. When the force acts on the first arm, the other arm damps the movement of the first. Beside the last case, this chain guide is more complex to manufacture and to use.

The solution presented in Table 1, E [11] is a fixed chain guide, having the role to take eventual shocks from the transmission system. The surface of the chain guide at contact between the chain and the metal support of the skid is made from plastic.

The solution presented in Table 1, F [12] f is a tensioning system with a gliding chain guide. Beside the last case, this guide can be placed on the whole surface of the passive branch and can better damp eventual shocks.

The solution presented in Table 1, G [13] is a chain guide having a specific stiffness, so that it acts as shocks absorber patent. Such a guidance mechanism can be used on internal combustion engines and on motorcycles.

The solution presented in Table 1, H [14] is a complex tensioning system having a hydraulic actuator with two pistons which constantly act on the chain guide giving a precise tension on the active strand of the chain. Along with the chain guide form the last point it forms the chain guide system.

The solution presented in Table 1, I [15] is a hydraulic actuator with two pistons with spring which act independently one from another. The actuator acts in two steps giving the possibility of controlling the tension on the active strand of the chain.

The solution presented in Table 1, J [16] is a tensioning system with a gliding chain guide which is actuated by a force pressing on the elongated end of the chain guide. Referring to the last case this system is actuated with a force that later it distributes in an invariable manner.

This solution means a progress from the viewpoint of reducing noise and they and provide no lubrication to a sliding sections, in which an environment (for example, an applied bearing pressure and a using temperature) where a plastic sliding material is used become increasingly severe.

3. CONCLUSIONS:

Many chain guide structures are known in the prior art. A systematization can be performed based on criteria of construction of chain drive system.

Typical chain guides for engine timing systems have been made of metals and composite materials such as glass-reinforced polymers. Increasingly, chain guides are made of plastic.

The guide support the chains employ in engine timing systems are used in order to avoid loss of control in the chain strands between the sprockets, but an effective chain guide must have some flexibility to prevent over-constraining of the chain, which could lead to the chain breaking.

In future work, the authors intend to bring improvements in order to eliminate the vibrations from the chain drive system. The result is the reduction of the vibration and also the reduction of the noise in engine.

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