Strike action electromagnetic machine for immersion of rod elements into ground

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Abstract. During construction, survey work, and drilling shallow wells by striking, operations associated with dipping and removing the rod elements are the most common. At the same time relatively long, with small diameter, elements, in which the ratio of length to diameter l/d is 100 or more, constitute a significant proportion. At present, the application of power pulse linear electromagnetic motors to drive drum machines is recognized to be highly effective. However, the mechanical method of transmission of shocks does not allow dipping long longitudinally unstable core elements. In this case, mechanical energy must be transferred from the motor to the rod through its side surface. The design of the strike action electromagnetic machine with a through axial channel for non-mechanical end striking of the pile of long, longitudinally unstable metal rods is proposed. Electromagnetic striking machine for non-mechanical end striking rod elements provides operations characterized by ecological compatibility, safety and high quality.

1. Introduction

During construction, survey work, and drilling shallow wells by striking, operations associated with dipping and removing the rod elements are the most common. At the same time relatively long, with small diameter, elements in which the ratio of length to diameter l/d is 100 or more constitute a significant proportion [2, 5].

At present, the application of power pulse linear electromagnetic motors to drive drum machines is recognized to be highly effective [1, 3, 4, 6].

However, the mechanical method of transmission of shocks does not allow dipping long longitudinally unstable core elements. In this case mechanical energy must be transferred from the motor to the rod through its side surface [2].

During non-mechanical end striking of the long and longitudinally unstable elements, when the transmission of shocks is carried out in an arbitrary section through the lateral surface of the rod, a special clamping mechanism in the device of mechanical power transmission is required, the circuit of which provides a radial clamping force and the adhesion force "anvil – rod" precluding slippage of the machine on the rod. This condition is easy to achieve in the case of applying the transmission device of mechanical energy V transmission, which has the structural simplicity and small size and weight characterized by large ratios [2, 7, 8].

2. Subject of research

Clamping mechanism with the so-called self-locking wedge mating with the mechanical elements of the positive opening operation, first proposed, investigated and applied in the annular pneumatic percussion mechanisms, is of most interest for strike action electromagnetic machine [2]. The constructive scheme of the device is shown in Fig. 1. Automatic forced opening of the wedging elements 5 in the process of driving happens every time during the interaction of the levers 6 and thrust bearing 8. At the same time, there is automatic without operator intervention movement of the strike machine along the rod in the opposite direction of driving, and then automatic consolidation on the rod at the new level.

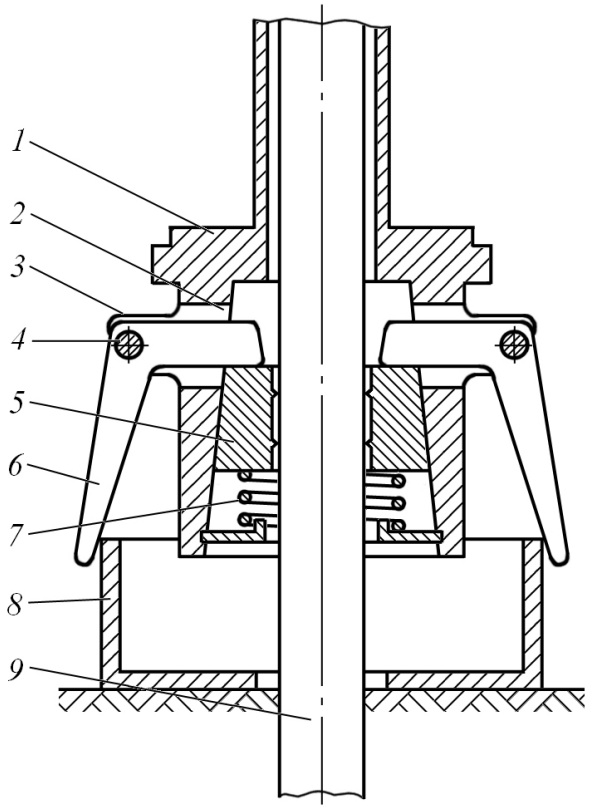

Figure 1. The structural diagram of the clamping mechanism with a self-locking wedge pair: 1 – anvil; 2 – window; 3 – bracket; 4 – axle; 5 – wedging element; 6 – an arm; 7 – return spring; 8 – thrust bearing; 9 – rod.

The strike system (Fig.2) is characterized by the angle of taper of anvil wedge-shaped coupling and the outer surface of the wedging elements – α; height wedging elements – h_e; the distance from the plane of impingement of the anchor from the anvil to the upper end of the wedging elements – Z; the length and outer diameter of the anvil L_a, D_a; length and diameter of the projectile L_p, D_p; type of the working surface of the wedging elements in contact with the side surface of the rod. The parameters of the V-clip are convenient to represent

$$\lambda_a=L_a/L_p;\ \lambda_e=h_e/L_a;\ \lambda_z=Z/L_a,$$

numerical values of which are $0<\lambda<1$.

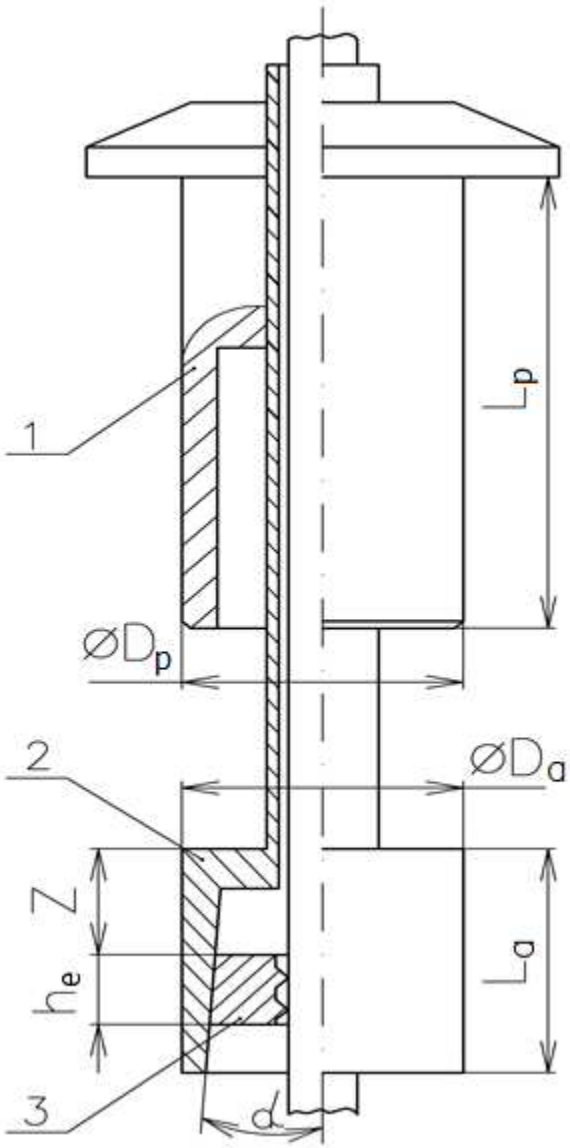

Figure 2. The basic elements and parameters of the system transmission of strike pulses are: 1 – the drummer 2 – the case of the fixture, 3 – wedging elements

To improve the efficiency of transmission of striking energy, there should be a tendency towards possible increase in parameters λ_a (0.6…0.85) and λ_z (0.4…0.7) and decreasing λ_e (0.4…0.3), that is, to narrow the length of the anvil and the striker, to reduce the height – h_e wedging elements and to shorten the distance from their upper end to the plane of impact of a striker with an anvil.

The design of the V-mechanism is further simplified if the forced opening elements 5 and automatic relocation are not necessary, since the elements 3, 4, 6, 8 are excluded. This device can be easily and very smoothly linked to the design of electromagnetic machine of striking action with a shutter of the cylindrical liner electromagnetic engine (LEME) and creates obvious opportunities for extending their functionality.

The aforementioned guidelines are used in the development of electromagnetic strike machines [2, 9, 10] with non-mechanical interaction "striker – tool", the construction of which is shown in Fig. 3

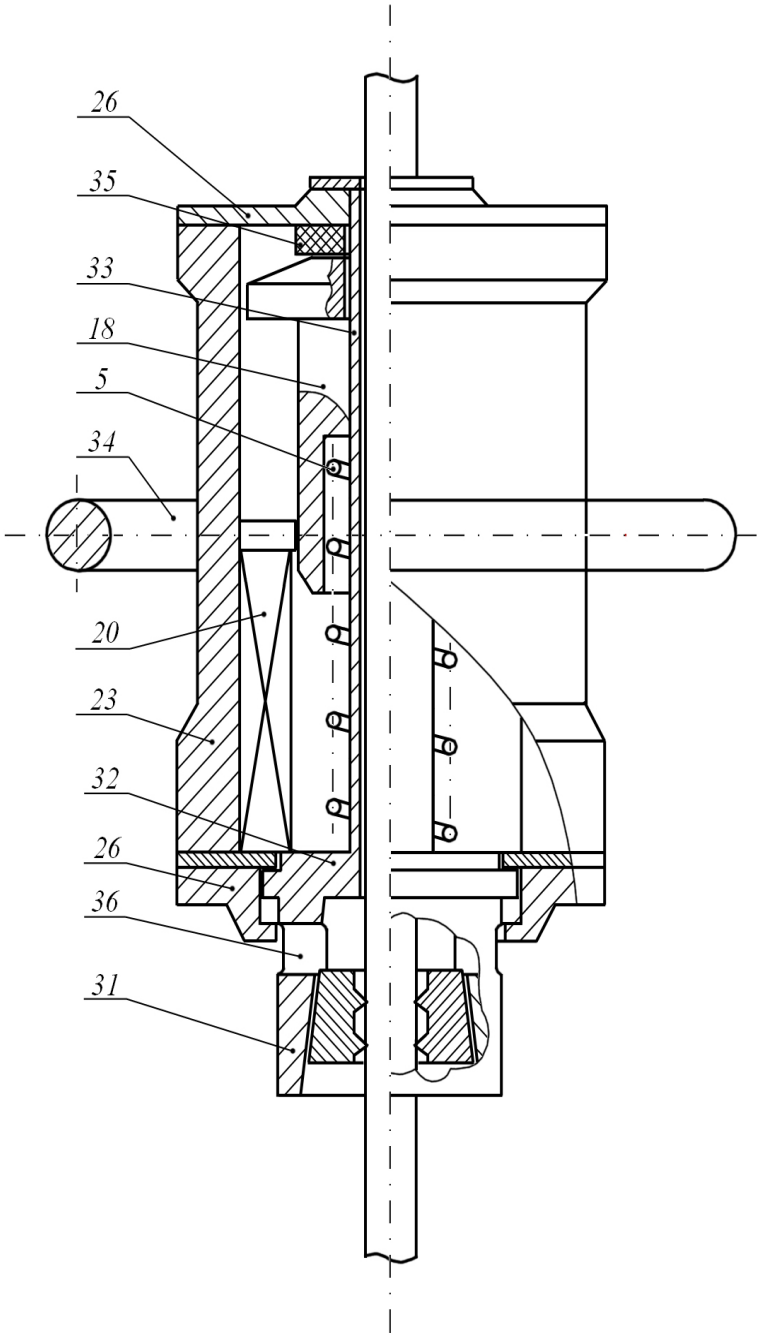

Figure 3. Strike action electromagnetic machine with a through axial channel

The strike action electromagnetic machine with a through axial channel (Fig. 3) is intended for driving (pulling) in-ground light longitudinally unstable building elements, electrodes, grounding, etc. The presence of the axial channel allows setting it on a long rod with relatively low stiffness near the ground surface and thereby eliminating the disadvantageous phenomenon of the loss of longitudinal stability of the rod while driving [11, 12].

The main elements of the machine – housing-stator 23; the cap base 26; the armature 18 with combined form; winding 20; a handle 34. The housing 31 of a clamping mechanism, an anvil 32, a guide 33 for the driven core and the armature 18 are made of one part, which has a free, axial, and limited movement relative to the housing 23 of the machine.

Retractable part of the armature 18 has an internal cylindrical groove for a helical return spring 5 placed on the guide 33. This arrangement substantially improves vibration and power characteristics of the machine, reducing the transmission of vibration to the housing 23 upon impact of the armature 18 on the anvil 32. During the reverse movement this aim is achieved by the buffer 35. Non-automatic opening of the clamping mechanism is made through the slots 36 in the housing 31.

Specially fabricated removable working tool (pointed, flat, with a cutting working edge, etc.) can be installed, if necessary, in the clamping mechanism instead of the rod to increase the functional versatility of the device.

3. Conclusion

The design of the strike action electromagnetic machine with a through axial channel for non-mechanical end striking of the pile of long, longitudinally unstable metal rods is proposed.

The strike action electromagnetic machine for non-mechanical end striking of the rod elements provides operations characterized by ecological compatibility, safety and high quality.

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