The prospects of hybrid laser-plasma cutting of metals have been justified, a design of an integrated plasmatron for hybrid cutting was proposed and the results of laser-plasma cutting of carbon sheet structural steels using such an integrated plasmatron were forecasted. It was shown that in order to minimize losses of laser radiation and obtain maximum penetration, it is advisable to assemble the integrated plasmatron according to a coaxial scheme with an axial arrangement of laser radiation and a minimum inclination of non-consumable electrodes (one or more), the distance from the working end of which to the axis of the laser beam should lie in the range of 2...3 mm. The diameter of the plasma-forming nozzle should lie within 2–5 mm and depth of focus under the surface of the cut sheet during hybrid cutting should be 1–2 mm. To simulate the processes of laser, plasma, and hybrid cutting, the SYSWELD software package was used which became possible due to taking into account the characteristic for cutting effect of removing sections of molten material in the cutting zone, performed by replacing the maximum overheating temperature during the calculation with the initial temperature (20 °C). The main parameters of the regimes of laser-plasma cutting were established which has made it possible to obtain minimum HAZ size with cut quality approaching that of the laser cut. At the same time, hybrid cutting requires an energy input of approximately half that of the air-plasma one. An increase in the speed of hybrid cutting by increasing the pressure and consumption of working gases makes it possible to compare energy input with the same indicator of gas laser cutting with more than a three-fold increase in the productivity of the process.

Keywords: hybrid laser-plasma cutting, integrated plasmatron, structural carbon steel, thermal cycle, heat-affected zone (HAZ), mode parameters.

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calculations without the use of the upper estimate, does not exceed the extrusion process. The margin of error, compared to numerical form as a function of the geometric and technological parameters of the magnitude of the reduced deformation pressure in the analytical module of the triangular shape of the transition zone from the radial ply an upper estimate of the power of forces that deform a kinematic steady stage of the deformation process. It has been proposed to describe the sites of intense deformation, which correspond to the dial-direct extrusion with compression with the presence of triangular kinematic modules. The use of the triangular kinematic modules have confirmed. The calculation scheme of a given process, developed on the basis of an energy method, makes it possible to predict the force mode for the steady stage under different technological parameters of the deformation process. The data acquired on the estimation of the optimal parameters for tool configuration would help devise appropriate design and technology recommendations.

**Keywords:** combined extrusion, upper estimate, kinematic module, energy method, deformation process, components with a flange.

**References**

This paper describes the advantages of using gas motor fuels by re-equipping the diesel engines with gas ICEs and thus reduce its cost.

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DOI: 10.15587/1729-4061.2020.1987700
DESIGNING THE SHAPE OF THE COMBUSTION CHAMBERS FOR GAS ENGINES CONVERTED ON THE BASIS OF THE DIESEL ENGINES (p. 23–31)


16. Regulation No. 67. Uniform provisions concerning the approval of: I. Approval of specific equipment of vehicles of category M and N using liquefied petroleum gases in their propulsion system; II. Approval of vehicles of category M and N fitted with specific equipment for the use of liquefied petroleum gases in their propulsion system with regard to the installation of such equipment.


18. Regulation No. 120. Uniform provisions concerning the approval of internal combustion engines to be installed in agricultural and forestry tractors and in non-road mobile machinery, with regard to the measurement of the net power, net torque and specific fuel consumption.


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A prototype of the universal resonance vibratory machine of wide use has been designed. The base of the vibratory machine is a vibratory table. Elastic supports make it possible for the platform of a vibratory machine, which has three degrees of freedom, to execute three main vibrational motions corresponding to three resonant frequencies. The vibration exciter is shaped in the form of a ball auto-balancer. It is assumed that the balls in the auto-balancer would get stuck at the first resonance shaft rotation velocity. The first form of resonance oscillations would be induced in this case.

The vibratory table can be used on its own. In addition, the platform can host attachments with sieves for sifting or separating a loose material, a tumbling container, molds for bricks, slabs, etc.

The experimental study has established that the proper choice of the number of plates in the supports, the number and mass of the balls could ensure almost matching dynamic characteristics of the vibratory machine in the configurations including a vibratory table and vibratory separator. At the same time, when the shaft rotates at speeds exceeding the first resonance frequency, the platform executes (almost undisturbed) vertical progressive oscillations. As the shaft’s rotation speed increases, the platform’s oscillation amplitude increases while the frequency practically does not change. If the shaft rotation speed exceeds the first resonance frequency by 15–20 %, the accelerations of the platform become sufficient to form a boiling layer at the surface of the platform. As the shaft’s rotation speed increases, the growth of the amplitude of oscillations slows down, which is due to both the sliding of the balls along the track and the non-linearity of the supports at large deformations.

The current study has confirmed the efficiency and versatility of the designed vibratory machine, thereby providing the basis for its further improvement.

Keywords: resonance vibratory machine, vibration exciter, vibratory sieve, vibratory separator, vibratory table, resonance vibrations, Sommerfeld effect.

References


The current study of computer implementation of the algorithm for determining a thread tension on technological equipment using recursion has established the values of thread tension before a zone where fabric and knitwear form on the technological equipment. It has been proven that the magnitude of thread tension before the formation zone is influenced by the number of guides in each particular technological machine, the curvature radius of each guide, the angle at which a thread wraps the guide, the angle of a thread's radial wrap, the thread's physical-mechanical and structural characteristics. The values of the angles at which a thread wraps the guides and the radial angles at which a thread is wrapped by the surface of a guide are defined by the geometric parameters and the design of both the thread feed system on technological equipment and specific guides. As a result, it has become possible at the initial stage of designing a technological process to determine thread tension before the formation zone, depending on the equipment geometric and structural parameters and the thread physical-mechanical and structural characteristics. The difference of 2–6 % between the experimental and calculated values of the tension confirms the correctness of the assumptions made when constructing the model of interaction between the thread and the guide, taking into account its physical, mechanical and structural characteristics, and the possibility of using recursion to sequentially determine the tension in the zones of technological equipment from the entrance zone to the fabrics and knitwear formation zone. Specifically, it has been established that the thread tension increases from a zone to a zone and reaches its maximum before the formation zone. It has been shown that the increase in tension by 9–15 % leads to a disruption of the technological process and the break of the thread.

Thus, there is reason to argue about the possibility, at the initial stage of designing the technological process of fabric and knitwear production, to regulate the thread tension before the zone where fabric and knitwear form. This could be achieved by adjusting the geometric parameters and design of both the thread feed system on the technological equipment and specific guides, which would minimize the value of thread tension.

Keywords: recursion algorithm, thread tension, guiding surface, curvature radius, wrap angle.

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The study employed the known modular software complex «Integration 2.1». The engineering and navigational calculation was performed for a typical flight profile of a long-range aircraft. The possibility of reducing fuel consumption by up to 20 % has been shown. The largest impact on the decrease in fuel consumption is exerted by the flow laminarization on the surface of the glider elements; the reduction in fuel consumption was 17.1 %. The abandonment of mechanization and ailerons decreases fuel consumption by 3.9 %, while the abandonment of ailerons, slats, and flaps reduces fuel consumption by 0.4, 1.5, and 0.4 %, respectively. The use of spiral winglets made it possible to reduce fuel consumption by 1.95 %.

**Keywords:** aerodynamic quality, fuel efficiency, adaptive wing, artificial laminarization, spiral winglets.

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DOI: 10.15587/1729-4061.2020.198724

PRESSING TECHNOLOGY AND BURNING QUALITY OF SPHERICAL FUEL BRICETTES MADE FROM AUTUMN LEAVES (p. 60–72)

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A process has been developed to press fuel briquettes from autumn leaves. It has been shown that a spherical shape of a briquette is optimal since even dense packing of balls provides air access to each individual ball. This is especially important in the initial phase of burning when briquettes touch each other and gain a certain temperature, because of the quality of burning increases. The technology of briquette pressing has been devised. We studied dispersion of particles of dry leaves of nutwood, maple, and oak after grinding and found that particle size distribution of powders of different leaves is not the same, and their bulk density is proportional to size with the highest content.

A new method for pressing briquettes in a round closed matrix has been proposed. The difference of the method is in the fact that the process takes place at the creation of a scheme of all-embracing uniform compression with a spherical form of application of force and obtaining of a ball-shaped briquette in the final phase. The method makes it possible to compress ground leaves radially and evenly and thereby to ensure equal burning conditions for a briquette in a radial direction from any point on the periphery. We derived a mathematical model of the dependence of the density of dry briquettes on the bulk density of ground leaves and the degree of compression of a briquette. It has been shown that the bulk density of ground leaves (65%) has the greatest influence on the density of dry briquettes. An increase in the bulk density of ground leaves leads to an increase in the density of dry briquettes. The influence of the degree of compression of a briquette is much smaller (35%) but it is significant. Its increase leads to an increase in the density of dry briquettes. The density of dry briquettes was from 0.67 to 1.07 g/cm³.

The density of dry briquettes is significant. Its increase leads to an increase in the density of dry briquettes. The influence of the degree of compression of a briquette is much smaller (35%) but it is significant. Its increase leads to an increase in the density of dry briquettes. The density of dry briquettes was from 0.67 to 1.07 g/cm³.

Keywords: pressing technology, spherical briquette, autumn leaves, briquette density, briquette burning.

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of 1,400 min\(^{-1}\), the oscillation amplitude of 0.5 mm and processing parameters: oscillation frequency of the processing tool working surfaces of plowshares have made it possible to determine of restoring worn surfaces. Experimental studies on hardening the establishing characteristic requirements for the technological process of change in the share shape and thickness of the cutting edge and processing. The studies have made it possible to determine the nature of wear resistance. An analysis of the wear of machine parts has made it possible to establish characteristic requirements for the technological process of restoring worn surfaces. Experimental studies on hardening the working surfaces of plowshares have made it possible to determine processing parameters: oscillation frequency of the processing tool of 1,400 min\(^{-1}\); the oscillation amplitude of 0.5 mm and processing time of 20 s. Studies of the influence of conventional and vibration working on strength characteristics were carried out first on models and then on actual parts. New shares served as models. Experimental studies of these shares provided the identity of the nature of the cutting element wear. The sameness of the model and the actual part deformation degree was provided by the same conditions of the passage of the hardening processes. The trustworthiness of the results of experimental studies was assessed in accordance with the law of theoretical distribution at a given value of confidence probability \(\alpha=0.05\). The studies have established that the share width of 116–117.5 mm which has a certain effect on the share efficiency corresponds to the highest probability of 0.39. It has been experimentally established that the degree of hardening of the shares made of L-53 steel and surfaced with somrite and vibration hardened is 1.85 times greater than in conventional processing. The studies have made it possible to determine the nature of change in the share shape and thickness of the cutting edge and choose a more efficient process of its restoration by vibration hardening. A method of recovering shares by welding strips of 45 steel with automatic hard surfacing and vibration hardening was proposed.

**Keywords:** deformation, wear dynamics, vibration processing, surface wear resistance.

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Nipple rubber is an important part of a milking machine, one of its key elements. This is the only component of a milking plant that has direct contact with the surface of a cow udder. In addition, nipple rubber is the most loaded component of a milking machine. During the milking process, it is compressed and unclenched more than 500 times. In order to maximize the effect of the use of rubber, it is necessary to calculate the conditions of its use correctly, to monitor technical parameters in due time. The task of the study is to establish changes in the technical parameters of the nipple rubber of milking machines and their impact on the performance of the article.

In the course of the research, it was established that the service life of all kinds of nipple rubbers was 1,000 hours, which, if used for 8 hours a day, corresponds to 125 days or 4 months of service life of all kinds of nipple rubbers. When used for 1,000 hours, the rubber stiffness varies. The weight of an article changes by ±0.939 between the nipple rubber stiffness and milking intensity was found. The studied indicators are important for determining the performance and nipple rubber suitability for use. The conducted research offers a real possibility of taking into consideration the qualitative parameters of nipple rubber during their selection and subsequent operation.

**Keywords:** nipple rubber, milking machine, milking cup, control of rubber parameters, operation of nipple rubber.

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