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SOFTWARE CONCEPT OF SMART DIGITAL TECHNOLOGICAL DEVELOPMENT

Formation of an innovative software concept for smart digital technological development of an intelligent investment object using elements of artificial intelligence and artificial neural networks

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The increasing complexity of modern engineering systems, particularly electronic and microelectronic devices, has fundamentally transformed the principles governing their protection as objects of complex, multidimensional, and multifunctional intellectual property. In such systems, distinctions based solely on structural features, circuit designs, or their combinations no longer fully define the essence of an invention. In contemporary practice, these characteristics can often be realized in an operable system or prototype only under specific technological conditions of manufacturing and control, with the fabrication process itself frequently determining the key properties of the invention.

The development of processor-based control systems has become a critical factor in the viability of technical solutions. As a result, algorithms, software programs, and feedback mechanisms between structural or circuit elements have become an integral part of the technical concept underlying a claimed invention.

Accordingly, a single invention description must integrate multiple heterogeneous technologies. The mechanisms, interaction channels, and interdependencies of such integration must be clearly reflected in the patent claims to ensure the unity of the inventive concept and to prevent its fragmentation into isolated technical solutions. The emergence of new technological fields - such as nanoscale metrology, nanoscale metallurgy, nanoscale ceramics, nanoscale metal - ceramics, and the widespread use of composite materials - has fundamentally altered the criteria and approaches used to assess the patentability of modern technical solutions.

Keywords: *Software concept; Smart digital technological development; Compositional technical solutions; Integrative technical solutions; Software products; Equivalents of integrative inventions; Classical methods of new technology and engineering development; Fundamental driving basis for the creation of software products as equivalents of integrative inventions; Integrative patent; Software-based design system; Accumulated technical solutions*

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Contents

Integrative Technical Solutions in Software Products and Methods for their Protection as Intellectual Property

The substantial increase in the complexity of modern engineering systems, particularly various types of electronic and microelectronic devices, has fundamentally transformed the principles of their protection as objects of complex, multidimensional, and multifunctional intellectual property.

For such objects, distinctions based solely on structural features, circuit designs, or combinations thereof no longer define all aspects of an invention, since today these characteristics and differences can very often be implemented in a functioning system or prototype only under specific conditions and capabilities of manufacturing and control technologies. In many cases, it is precisely the manufacturing process that determines the principal properties of the invention.

The development of processor-based control systems also determines the viability of a technical solution; therefore, algorithms, software programs, and feedback mechanisms between structural or circuit elements become – or have already firmly become – an organic part of the technical solution underlying the claimed invention.

Thus, within a single description it becomes necessary to combine or integrate several different technologies. This integration, along with the identified interaction channels and interconnections, must be presented in the patent claims in such a way as to prevent a patent office examiner from questioning the unity of all integrated distinguishing features of the

prospective invention and from dividing it into a number of localized technical solutions based on a single technological direction.

The influence of recently emerging technological fields – such as nanoscale metrology, nanoscale metallurgy, nanoscale ceramics, nanoscale metal–ceramics, the widespread use of composite materials, and similar developments – has fundamentally changed the approach to qualifying technical solutions with respect to their compliance with the criteria of patentability.

In order to keep pace with technological progress and to create market-demanded technical solutions, inventors are therefore compelled to seek ways to integrate within their technical solutions both well-known, so-called classical methods of idea synthesis and their implementation in products or technologies, as well as new approaches arising from the unprecedented capabilities offered by recently developed complex technological fields and the results of scientific research and highly sophisticated technical and experimental studies.

This is particularly relevant to those objects of technical creativity that can be integrated into the overall technological context only in combination with software, through the use of computer modeling and simulation, programmable processor-based systems, and high-sensitivity sensors with resolution equivalent to angstroms rather than microns.

Such integration often requires an entirely different approach to solving the challenges posed to the innovation process and to the inventor by the evolution of engineering and technology.

What tools currently exist to assist the inventor at the stage of conceptualizing an innovative idea, enabling the analysis, verification, evaluation, and modeling of the most complex interrelationships that arise during idea synthesis and its implementation?

The most effective, mobile, and precise approach is the use of computer-aided design software systems of the **SolidWorks** family.

The extensive capabilities of this group of programs, their flexibility and adaptability to various conditions and criteria, and the ability to construct animated visualizations and operational processes of a technical solution based on digital models make it possible to clearly assess the novelty and the realistically achievable degree of integration of such a technical solution without resorting to the costly process of physical prototyping.

As an example, modeling versions of a component of an integrative technical solution – a vortex generator – are presented. This component enables the formation of a vortex tube within a flow consisting of two or more gaseous components.

As can be seen from the presented model, all complex geometric elements of the generator, all surface transitions, dimensions, and combinations of surfaces and sizes are elaborated in the model with high precision. Moreover, all required dimensional tolerances, material properties, cutting tool capabilities, and the kinematic characteristics of the numerically controlled machining center are digitally embedded in the model. For the realization and manufacturing of the generator, it is sufficient to transfer the complete digital information of the component to the machining center.