dimensions, which in turn reduces volumetric efficiency and makes it difficult to achieve the volumetric minimization to which persons skilled in the art aspire.

At the same time, in the transmission field, beveloid gear transmissions (also referred to as conical involute gears) are known to be used for transmitting rotational mechanical energy from one point to another and enable producing a crossing angle or skew axes between two intermingled gears. Beveloid gears have long been used for marine applications and in the automotive field (e.g. in four-wheel drive vehicles for transmitting torque and rotational motion from the gearbox to the front axis that may not be in a parallel position).

Beveloid gears have been analyzed and discussed in the following publications:

H.E. Merritt, "Gears", Pitman, London, 1955, pages 165- 170;

A.S. Beam, "Beveloid Gearing", Machine Design, Vol. 26, December, 1954, pages 220-238;

S.C. Purkiss, "Conical Involute Gears: Part 1", Machinery 89, 1956, pages 1403-1420; and

C.C. Liu, C.B. Tsay, "Contact characteristics of beveloid gears", Mech. Mach. Theory, No. 37, 2002, pages 333-350.

Summary

The invention solves the minimization and volumetric efficiency challenges faced by skilled persons, who are designers of mechanisms used for steering and maneuvering airborne bodies, and overcomes the shortfalls in the prior art previously discussed in the “Background of the Invention” chapter by implementing beveloid gears as a means for transmitting power from the electric motors in the assembly to the angular motion axes of the fins in the airborne body, in a manner that allows for compact packaging of all the system components (motors, transmission, axes of the fins) in a circumferential, toroidal ring like assembly, on a single plane, while enhancing propulsion performance of the airborne body’s fins, at the required torque, precisely and with minimum backlash.

In one example, the disclosure is a mechanism used to steer and maneuver airborne bodies, whether in an FCAS assembly of an airborne body (e.g. in a rocket-propelled missile, jet-powered cruise missile, guided bomb or a guided artillery shell) or in a TVC assembly in a missile. A mechanism that comprises at least one actuator, which is comprised of an electric motor having a first axis and a gear transmission for transmitting power from the electric motor to an angular motion axis of a fin (e.g. tail wing) having an angular motion around a second axis to steer the airborne body by aerodynamic maneuvering manner or TVC, as aforesaid, and

wherein the mechanism in accordance with the invention, is characterized in that the said gear transmission is a beveloid gear type of gear.

In one aspect, the present disclosure refers to A mechanism for steering and maneuvering an airborne body comprised of at least one actuator comprising an electric motor having a first axis, and a gear transmission for transmitting power from said electric motor to an angular motion axis of a fin that has an angular motion around a second axis to steer the airborne body by aerodynamic maneuvering or TVC, and wherein the mechanism is characterized in that said gear transmission is a beveloid gear type of transmission.

In another and additional example of the disclosure, the beveloid gear transmission transmits power from the electric motor to the fin, wherein the motor axis is not parallel to the fin axis, but is positioned in creating an angle between the two axes.

In one example of the disclosure, the mechanism, which is used to steer and maneuver airborne bodies according to the disclosure, is an FCAS assembly of a missile having a rocket propulsion system along its central longitudinal axis, wherein the mechanism is comprised of a circumferential array of four actuators, and is characterized in that -

a. The circumferential array of the four actuators is installed in the assembly in an apparatus having a toroidal ring-like cross-section, which is adapted for installation around the rear section of the missile motor while encompasses it and merges with the missile's exterior line of design, and

b. Wherein the circumferential array of four actuators is packaged in one plane perpendicular to the central longitudinal axis of the missile, and

c. The assembly is adapted for installation of four fins on top of it, each of which has an angular motion revolving around an axis by means of the circumferential array of four actuators, and

d. In each of the actuators, the motor motion axis is not parallel to the fin axis, but is positioned in creating an angle between the two axes, and

e. Once the assembly is installed in the missile, the four fins serve as tail wings of the missile for steering it by tail control of the four fins.

In another and additional example of the disclosure, the invention is the airborne body that comprised a mechanism, which is used for steering and maneuvering airborne bodies according to the invention, whether in an FCAS assembly of any airborne body (e.g. in a rocket-propelled missile, jet-powered cruise missile, guided bomb or a guided artillery shell), or in a TVC

assembly in a missile. In other words, the invention is embodied in the airborne body in which the mechanism is installed, which is characterized in that the gear transmission used to transmit power from an electric motor to an angular motion axis of a fin having an angular motion that revolves around an axis, is gear transmission of beveloid gear type.

In another and additional example, the disclosure is a general method in the field of mechanisms, which are implemented to steer and maneuver airborne bodies, whether in an

FCAS assembly of any airborne body (e.g. in a rocket-propelled missile, jet-powered cruise missile, guided bomb or a guided artillery shell) or in a TVC assembly in a missile. That is to say, a general method in the field of mechanical systems that are based on fins that move in the desired direction and to the desired extent in order to achieve the desired flight path of an airborne body. A method that comprise the steps of -

a. Packaging the airborne body with an assembly comprised of gear transmissions of the beveloid gears type as a means for transmitting power from the electric motors in the assembly to the angular motion axes of the fins of the airborne body; and
b. Steering the airborne body by transmitting power, as needed, from the electric motors in the above assembly to the angular motion axes of the fins of the airborne body through the transmissions in order to change their position in an angular motion, thereby obtaining the desired flight path of the airborne body.

In another aspect, the present disclosure refers to a method for achieving the desired flight path of an airborne body by means of fins that move in the desired direction and to the extent required for achieving the desired flight path of the airborne body by aerodynamic maneuvering or TVC, which comprise the steps of packaging the airborne body with an assembly comprised of transmissions of beveloid gear type as a means for transferring power from the electric motors in the assembly to the angular motion axes of the fins of the airborne body; and b. steering the airborne body by transferring powers, as required, from the electric motors of said assembly to the angular motion axes of said fins of the airborne body through said transmissions of beveloid gear type in order to change their position in an angular motion, thereby obtaining the desired flight path of the airborne body.

Other examples of the disclosure will become apparent by consideration of the detailed description and accompanying drawings

BRIEF DESCRIPTION OF THE ATTACHED FIGURES

Different aspects of at least one embodiment of the invention that is the subject of the Patent Application will be described below, with reference to the accompanying figures (while no scale should be attributed to them). The figures are presented for illustrative purposes only and for facilitating an understanding of the different aspects of the invention and the possible configurations for its actual embodiment. The figures are part of the description, but should not be construed as limiting the invention in any way. In the figures, an identical or similar

element that is visually depicted in several figures could be tagged by uniform numbering. For clarity, not every element was tagged in each of the figures. In the following figures:

Fig. 1 schematically depicts in perspective the packaging challenge facing a person skilled in the art in the context of merely an exemplifying illustration of an FCAS assembly of a missile having a rocket propulsion system, wherein the assembly serves for steering a circumferential array of four tail wings.

Figs. 2 and 3 schematically depict (respectively) in a perspective view and partial cross-section side view, the prior art solution for the packaging challenge described above in reference to Fig. 1.

Figs. 4 and 5 schematically depict (respectively), in a perspective view and zoom-in perspective view, an example of an FCAS assembly according to the invention, as it is installed,