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[54] **DETACHABLE POWER MODULE FOR FLYING TOY AIRCRAFT**

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[52] **U.S. Cl.** ..... **46/243 AV**, 46/78

[51] **Int. Cl.** **A63h 29/22**

[58] **Field of Search** ..... 46/78, 93, 243 AV, 46/243 MV

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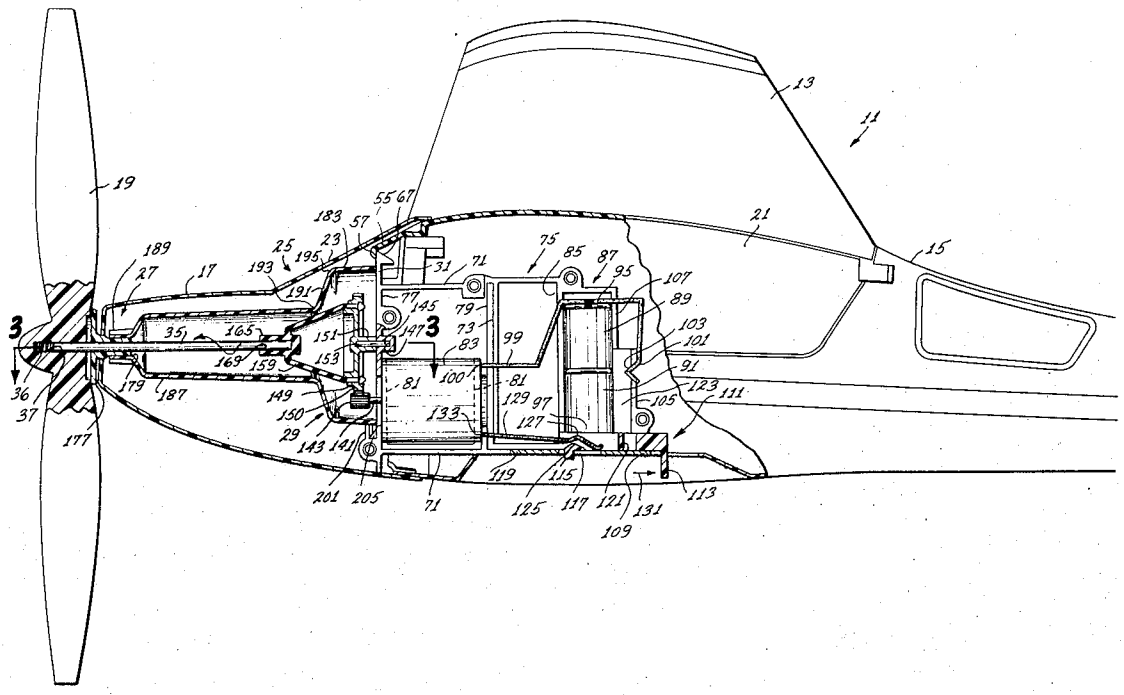
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Assistant Examiner—Robert F. Cutting
Attorney—Seymour A. Scholnick

[57] **ABSTRACT**

A completely self-contained detachable power module for removable attachment to a vehicle body, such as a flying toy aircraft fuselage, the module including a housing containing a rechargeable battery arrangement and a powerful miniature electric motor coupled through a drive arrangement to a driven element, such as a propeller, the housing also including attachment means for removably attaching the housing to a toy vehicle body.

10 Claims, 5 Drawing Figures



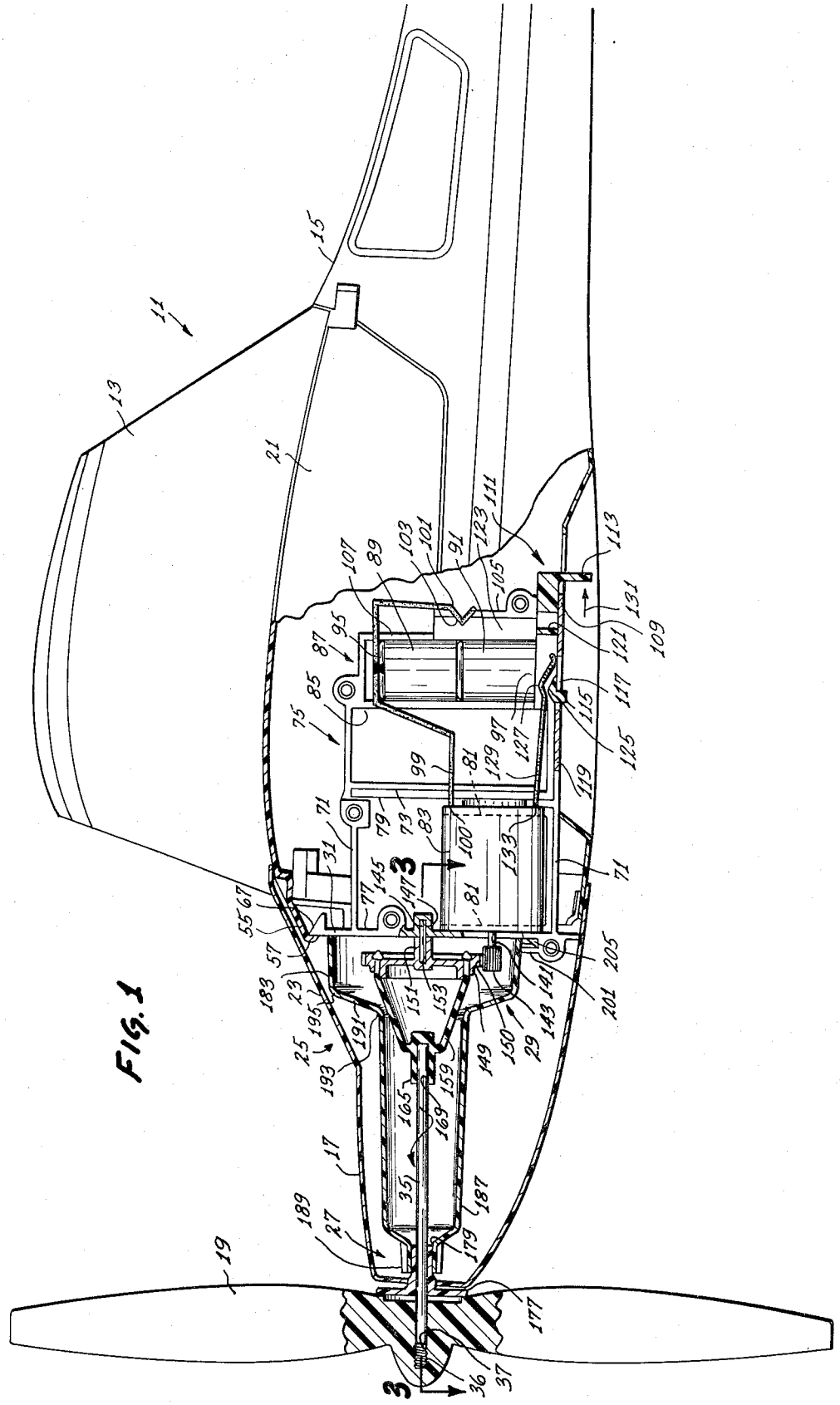
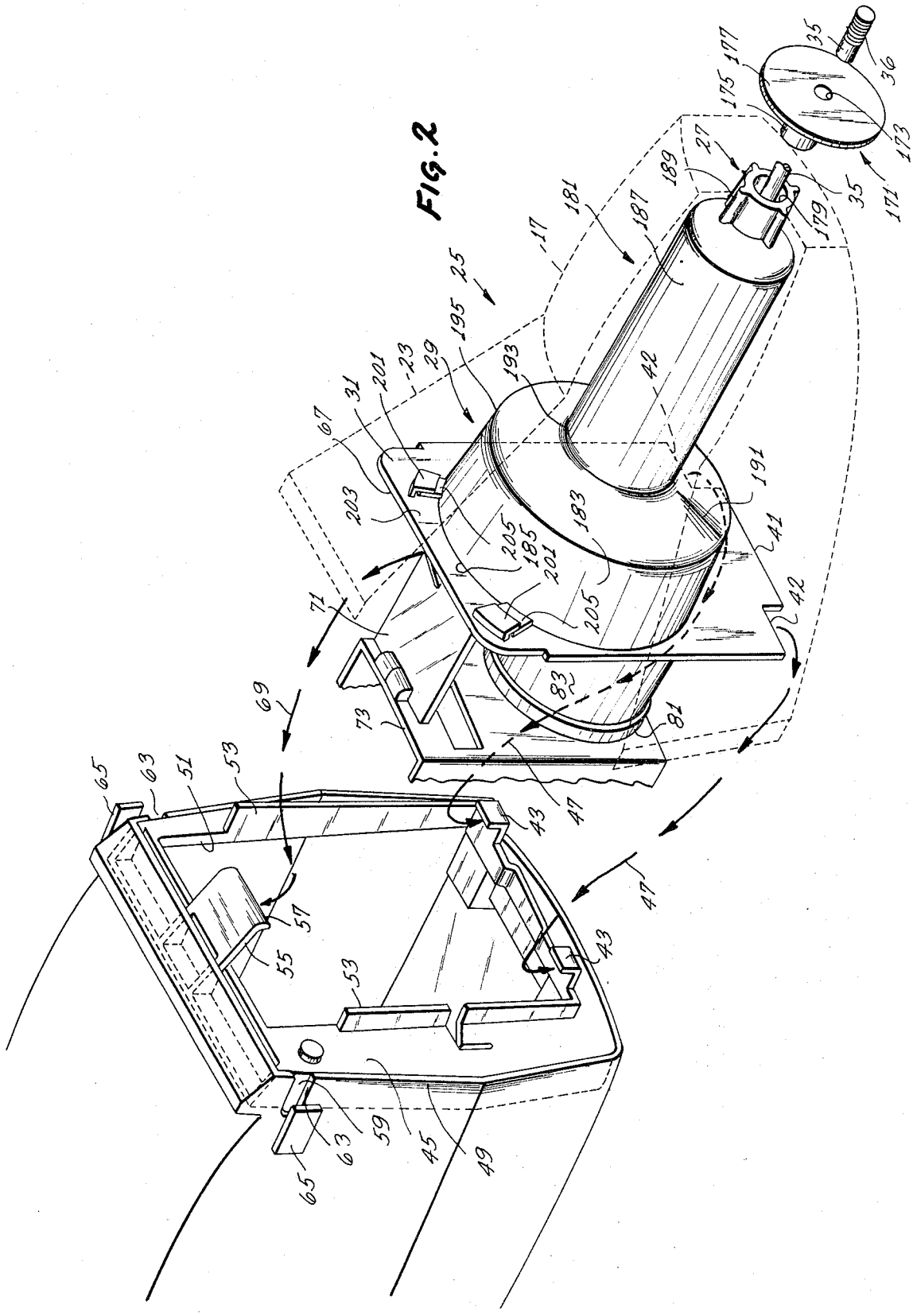

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FIG. 1

FIG. 2


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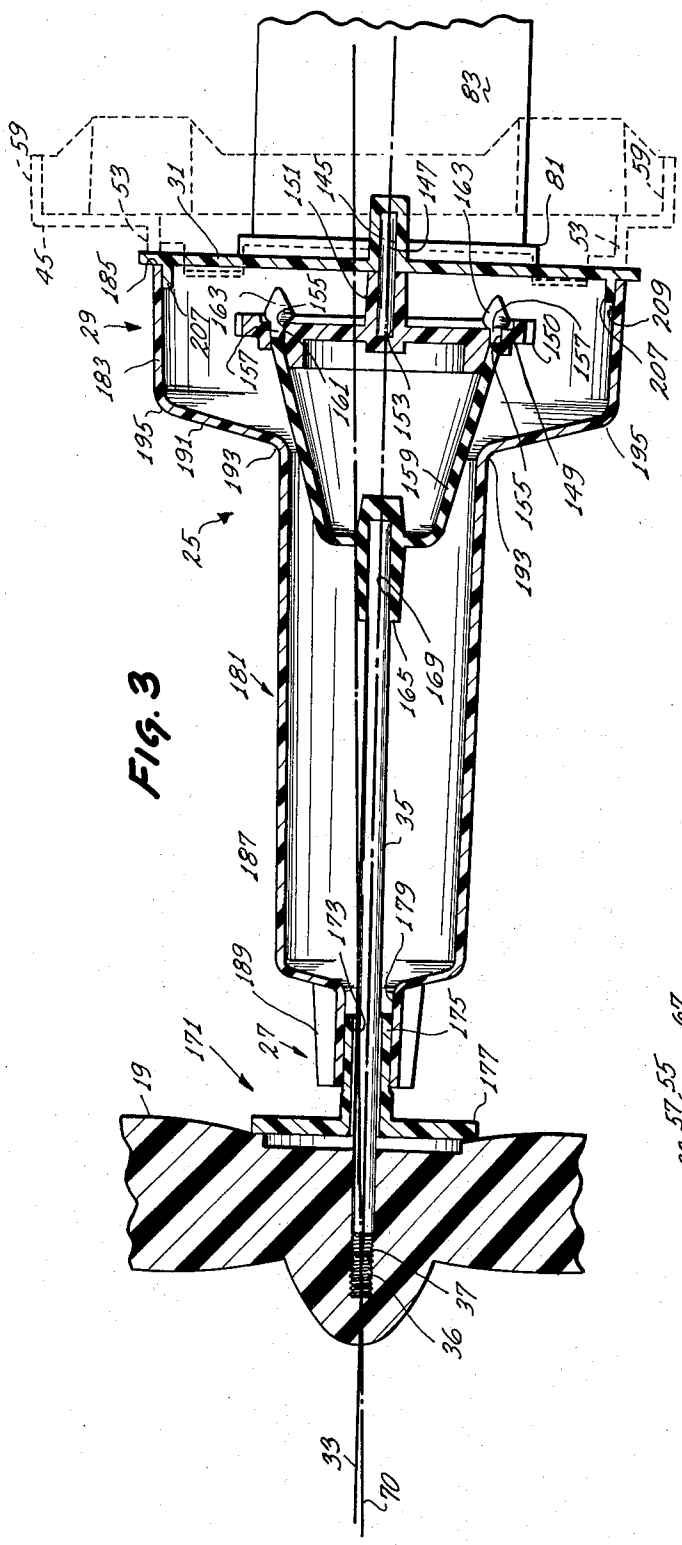


FIG. 3

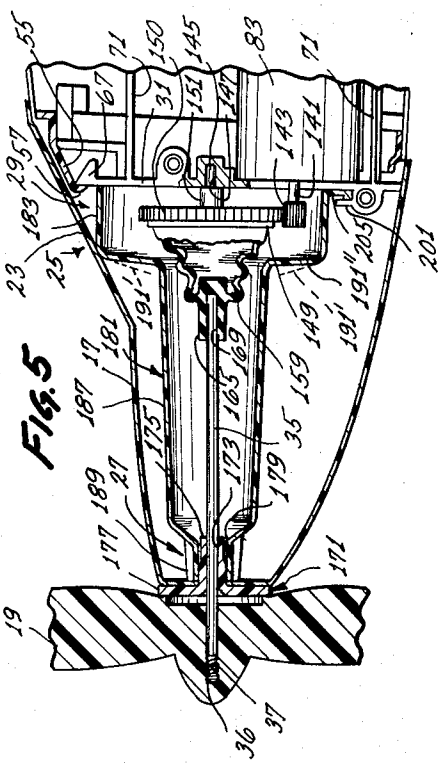


FIG. 5

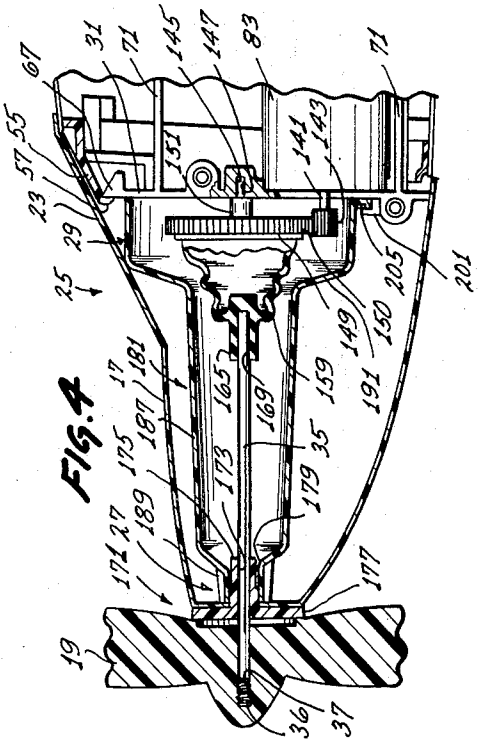


FIG. 4

DETACHABLE POWER MODULE FOR FLYING TOY AIRCRAFT

BACKGROUND OF THE INVENTION

The background of the invention will be set forth in two parts.

FIELD OF THE INVENTION

The present invention pertains generally to the field of toy vehicles and the like, and more particularly to detachable power modules for powered toy vehicles, such as propeller-driven toy aircraft.

DESCRIPTION OF THE PRIOR ART

Toy vehicles having self-contained electric motors for driving the wheels are well known. In most instances, the batteries used for driving these motors were of the dry cell types which must be replaced, usually after a relatively short period of use. The electric motors used were generally large, heavy and inefficient which readily led to battery exhaustion. The weight of these batteries and the motor precluded practical use of this type of motivation power to flyable toy airplane applications and, instead, small reciprocating engines have been utilized as the basic source of power.

These miniature reciprocating engines do not provide sufficient power to propel toy airplanes through the air, but also, they have the disadvantage of creating a high noise level. This factor has lead to the banning of these flying model airplanes in many locations adjacent to residences because the occupants of these homes were annoyed by the loud noise; some complaining of loss of sleep.

In order to alleviate this objectionable feature of reciprocating engine powered flying toy airplanes, much research and development work has been done in an effort to reduce the noise level of these power plants. In time, several new muffler designs were produced which reduced the noise level, but those which reduced the noise to an acceptable level generally either caused the reduction of driving power or added too much weight to the system.

In contrast to the prior art, the present invention takes advantage of the recently developed, relatively smaller, lighter, and efficient electric motors and rechargeable batteries to provide a powerful self-contained propulsion power package which exhibits great resistance to impact damage and which is easily and quickly replaced by a similar propulsion power package. Another advantage is that only one such power package is needed to power a number of different types of toy vehicles, such as propeller-driven boats and flying airplane structures. Also, the noise factor is virtually non-existent and the power plant is rechargeable without the use of highly toxic and dangerous flammable liquids for reciprocating engines.

SUMMARY OF THE INVENTION

In view of the foregoing factors and conditions characteristic of the prior art, it is a primary object of the present invention to provide a new and useful detachable power module for powered toy vehicles not subject to the disadvantages of the prior art ennumerated above.

It is another object of the present invention to provide a detachable power module for toy vehicles which

allows the use of one such module to power several products.

It is also another object of the present invention to provide a detachable power module for toy vehicles which incldes a propeller, a miniature but powerful electric motor with a suitable rechargeable battery arrangement, and a drive arrangement coupling the motor to the propeller.

It is still another object of the present invention to provide a virtually silent, electric-motor-powered, flyable toy aircraft assembly which facilitates repair and replacement of the power package and recharging of the self-contained rechargeable batteries.

According to the present invention, a detachable power module for removable attachment to a toy vehicle body or fuselage is provided which includes a propeller and a housing having a forward end and an attachment portion, with fuselage attachment means for removably attaching the housing to a toy vehicle body, such as an aircraft fuselage. Electric motor means for providing rotational power is also included, as well as drive means being disposed in the housing and operatively coupled to the propeller and to the electric motor means for transmitting the rotational power to the propeller. The invention may include a rechargeable battery arrangement electrically connected to a miniature electric motor, and the attachment portion of the housing may be a transverse wall or plate with the attachment means including an attachment bulkhead or frame mounted on one end of a toy vehicle body and adapted to hold the transverse wall or plate by a resilient holding tab and a holding bracket receiving and registering with an opposite side of the wall.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by making reference to the following description, taken in conjunction with the accompanying drawings in which like reference characters refer ro like components in the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view, partially in section illustrating the inventive structure and a flying toy aircraft carrying same;

FIG. 2 is a perspective view showing, in enlarged form, the forward portion of the toy aircraft of FIG. 1;

FIG. 3 is an enlarged sectional view of the nose portion of the aircraft structure taken along line 3—3 of FIG. 1;

FIG. 4 illustrates the reaction of the propeller housing structure of FIG. 1 to initial impact forces on the propeller; and

FIG. 5 illustrates how the propeller housing absorbs the impact forces without allowing the propeller shaft and the power train coupled thereto to be damaged.

DESCRIPTION OF THE INVENTION

Referring now to the drawings and more particularly to FIG. 1, there is shown for purposes of illustration, but not of limitation, a suitable toy vehicle, such as a flyable toy aircraft 11 having conventional wings 13, a body or fuselage 15, a cowling 17, and a propeller 19. The fuselage 15 may be provided with simulated windows 21 and a windshield 23 and other simulated fix-

tures and appendages, such as a landing gear, not here shown for the sake of simplicity.

Referring now also to FIG. 2, it can be seen that a forward housing or nose cone portion 25 is detachable from the vehicle's body or fuselage 15. The portion 25 has a forward or free end 27 and an attachment portion 29, the latter including attachment means (described in more detail later) for removably attaching the portion 25 to the fuselage 15. The attachment portion 29 basically comprises a transverse wall or plate 31 that lies in a plane orthogonal to the longitudinal axis 33 of a propeller shaft 35 rotatably disposed in the portion 25 and extending beyond the end 27 and seated at its threaded end 36 in a threaded bore 37 in the propeller 19. In this embodiment, the wall or plate 31 is generally rectangular and includes a lower indexing portion 41 having stepped members 42 registering with lower brackets 43 which are an integral part of bulkhead 45 fixedly attached to a forward portion of the fuselage 15 (note arrows 47 in FIG. 2).

The bulkhead 45 has an outer edge 49 which conforms to the cross section of the fuselage 15 and a generally rectangular central opening 51. The bulkhead 45 also includes forwardly-extending positioning means 53 and a resilient holding tab 55 with an inwardly extending lip portion 57. The tab 55 and the members 53 are preferably an integral part of the single plastic molded bulkhead member 45, which bulkhead may be either an integrally molded part of the aircraft fuselage or permanently attached thereto by conventional bonding means, such as a plastic cement, for example. In the latter case, the bulkhead will include a flange portion 59 which slideably fits within the fuselage and bonded thereat. Slots 63 are provided in the fuselage 15 to accommodate a pair of rubber-band tie-down members 65, the rubber band (not shown) being used to hold the wing 13 in place.

From FIG. 2, it can be seen that the nose cone portion 25 is removably attached to the fuselage 15 by first inserting the members 42 into the holding brackets 43 and then urging the upper edge 67 of the plate 31 into contact with the holding tab 55, as indicated by arrows 69. Additional rearward pressure on the plate 31 or the lifting of the tab 55 will allow the lip portion 57 to slide over the edge 67 and then down to hold wall 31 against the positioning members 53. These members 53 may be sloped and dimensioned to position the longitudinal axis 33 of the propeller shaft 35 relative to the longitudinal axis 70 of the fuselage for certain desired effects, such as counteracting the propeller torque for straight powered flight, with the control surfaces (not shown) in their neutral position, for example. This technique is well-known in the art and will not be described here in detail.

Extending rearwardly from the wall 31 are a pair of spaced, parallel broadly-flat arms 71 which terminate at a forward wall 73 of a rectangular open frame 75. The inner face 77 of the plate 31 and the forward face 79 of the wall 73 carry cylindrical lip portions 81 adapted to fit about and fixedly hold in place a powerful miniature electric motor 83, best seen in FIG. 1. Extending in back of a rear wall 85 of the frame 75 is a somewhat smaller battery compartment open frame arrangement 87 which securely holds, in this embodiment, a pair of tandemly-mounted, electrically-series-connected, rechargeable, nickel-cadmium batteries 89 and 91. This battery of cells 89 and 91 may be considered as a single battery arrangement 93 with a positive battery terminal 95 and a negative battery terminal 97 (the outer case of the lower cell 91).

A positive contact member 99 of a metal conductive material such as brass, for example, is bent to extend between and is permanently attached and electrically connected to one input terminal 100 of the motor 83 and to the positive battery terminal 95 of the battery arrangement 93. The member 99 also extends beyond the battery compartment 87 and finally terminates at a V-shaped positive charging plug tip contact 101 seated on supporting edges 103 of a recharging plug enclosure member 105 mounted at the rear wall 107 of the frame 87. A lower wall 109 of the frame 87 is in the form of a hollow conduit having a rectangular cross section which slideably houses an elongated switch member 111 with a switch operating depending tab 113. The member 111 includes a travel limit projection 115 moving in an elongated slot 117 in a lower wall portion 119 of the of the wall 109. A plug accepting hole 121 is also provided in the member 111 which hole registers with a recharging plug passageway 123, defined by the enclosure member 105, only when the member 111 is in its "off" position (extreme forward position).

The switch member 111 is also provided with an upwardly-extending tab 125 adjacent the forward end thereof. The tab 125 pushes a negative battery contact end 127 of a conductive negative contact member 129 into physical and electrical contact with the negative battery terminal 97 against the self-biasing resiliency of the member 129, only when the tab 113 is pushed in a rearward direction to its extreme rear or "on" position as indicated by arrow 131. Since the negative contact member 129 is permanently connected to a second motor input terminal 133, the electrical supply circuit to the motor 83 is complete when the contact end 122 is forced to touch the negative battery terminal 97, and the motor is thus activated.

In order to charge the battery arrangement 93, a conventional charging plug (not shown) having a tubular sleeve and an insulated tip is inserted through the hole 129 into the passage 123 until the plug's tip (positive polarity) contacts and registers with the tip contact 101, and the plug's sleeve (negative polarity) lies against and makes electrical contact with the negative battery terminal 97, which is the outer case of the cell 91. Once the battery arrangement has been charged, the charging plug may be removed and the tab 113 pushed rearward to energize the motor 83.

As can be seen in FIG. 1, the electric motor 83 includes a motor shaft 141 extending through an appropriate opening in the plate 31 and supporting a relatively small diameter pinion 143. Supported by a rotatably axle 145 rotatably extending through a bearing aperture 147 in the plate 31, is a relatively larger diameter coupling gear 149 having teeth 150 disposed about its outer circumference meshed with the pinion 143. As shown more clearly in the enlarged view of FIG. 3, the coupling gear 149 includes an axial spacer projection 151 with an elongated axial bore 153 wherein the axle 145 is fixedly attached. The gear 148 may be fabricated from any suitable substance such as a nylon material, for example, and the projection 151 may be an integral part of the gear 149, which projection maintains a minimum distance between the gears and the plate 31.

The gear 149 is further provided with holes 155 symmetrically spaced about the axis 35 to accommodate

and hold a similar number of projections **157** of a resilient coupling member **159.** The projections **157** extend from the base periphery **161** of the hollow truncated conical-shaped member **159** and include relatively larger-diameter retaining end portions **163** in order to hold the member **159** in position against the gear **149.** The coupling member **159** is designed to be compressible axially (see FIGS. **4** and **5**) and distorted laterally but still be able to effectively transmit torque between its base periphery **161** and its forward tubular axial projection **165.** It has been found that a rubber or neoprene material is suitable for this application, but other materials exhibiting the desired characteristics may be used. Alternately, the base periphery **161** of the member **159** may be bonded by any conventional process directly to the gear **149.**

An axial bore **169** is provided in the projection **165** with an inner diameter less than the diameter of the shaft **35** so that a significant friction grip is provided by the coupling member on the propeller shaft to transmit torque thereto. The shafts **35** is rotatably supported at the housing's free end **27** by a bearing element **171** including an axial bore **173,** provided in an axially aligned bushing portion **175,** and an annular disc portion **177.** The bushing portion **175** has an outer diameter to slideably fit within a bore **179** in the housing **25** adjacent the end **27** to support the shaft **35** thereat. The annular disc portion **177** has a diameter which is at least the spinner diameter of the propeller **19** so that impact forces are transmitted over the full area of the material.

In the embodiment illustrated in FIGS. **1–5,** the portion **25** includes a removable propeller shaft housing structure **181** having a relatively large-diameter hollow cylindrical rear portion **183** terminated at a rear peripheral edge **185** against the plate **31,** and an elongated tubular portion **187** with a ribbed reduced diameter forward portion **189** terminated at the end **27.**

Integrally joining the rear portion **183** to the elongated tubular portion **187** is a unique hollow truncated cone portion **191** exhibiting an approximately constant force characteristic with compressive displacement. The exact nature of this force characteristic associated with a given compressive displacement is determined by the material used, the thickness of the material in the truncated region, the smaller **193** and larger **195** diameters of this conical structure and the cone angle. The purpose of this configuration is to provide an advantageous shock absorbing feature as an integral part of the housing structure **25.** The portion **191** is in effect similar to a dish-shaped disc spring known in the mechanical art as a Belleville spring, although it is modified by its integral attachment to the cylindrical portions. Additional information concerning this type of device may be obtained by making reference to texts such as "Fundamentals of Machine Design" by C.A. Norman et al, published by the MacMillan Company, New York.

The design of the portion **25** is thus directed to the preventing or lessening of damage to the power train and air-frame structures and components, in the event of a severe compressive load inwardly exerted on the nose of the aircraft **11,** as when the latter crashes nose first to the ground or into a wall; an event which may occur when inexperienced persons control the craft or when natural forces of sufficient magnitude overcome the natural stability of the craft in flight.

Referring now more particularly to FIGS. **4** and **5,** the operation of the various structures and elements of the nose portion of the aircraft **11** to resist impact damage is illustrated.

Upon initial contact with the ground, for example, the propeller **19** and its attached shaft **35** will be pushed rearwardly causing some deformation in the resilient coupling member **159,** as illustrated in FIG. **4.** It can be seen that the member **159** is disposed between the inwardly moving shaft **35** and the gear **149** which cannot so move because of its spacer portion **151** being in contact with the plate **31.** The conical side walls of this member will thus buckle and absorb a certain amount of the energy without transmitting coercive force to the gear **149** or the plate **31.** The resiliency of the coupling member **159** also allows the rear end of the propeller shaft **35** to move laterially without deforming the shaft when the impact force exerted on the propeller **19** includes components in directions other than along the rotational axis **33** of the shaft **35.**

In the event that the force is greater than that which can be absorbed by the action of the coupling member **159,** the propeller will be pushed against the disc portion **177** of the bearing member **171,** which will in turn push against the end **27** of the nose cone portion **25.** This force will then be transmitted back along the rigid elongated tubular portion **187** of the truncated cone portion **191** which is fixedly anchored at its outer periphery **195** by the rigid hollow cylindrical portion **183** and the plate **31.** This compressive load will cause the more inward region of the conical portion **191** to deflect relatively towards the plate **31** rearwardly, at first at a relatively fast pace, but at a non-linear, increasingly lesser rate. The deflection of the member **191** is shown in FIG. **5** by comparing its original position (identified by the dashed outline **191'**) and its final position shown by the solid outline **191''.** By taking into consideration the mass of the aircraft **11** and the possible maximum volocity with which it may impact the ground or another object, one skilled in the art will be able to design a shock absorbing portion **191** which will abosrb the compressive energy so produced and prevent severe damage to the craft, particularly the motor, battery of cells and gear train, from excessive deceleration forces.

In order to facilitate assembly and removal of the propeller shaft housing **181,** a rotating-lock attachment arrangement is provided on the plate **31** and at the peripheral edge **185** of the housing's rear portion **183,** as best illustrated in FIG. **2.** This arrangement includes three spaced L-shaped retaining brackets **201** on the forward face **203** of the plate **31** and three associated tabs **205** extending radially from the edge **185.** To assemble these units, the tabs **205** are positioned against the plate's front face **203,** at one side of the brackets **201,** before rotating the housing **101** and thereby moving the tabs **205** into engagement with the brackets. Also, the front face **203** of the plate may include circular segment ridges **207** which register with the inner surfaces **209** of the portion **183** for proper axial alignment thereof.

From the foregoing, it should be evident that a very advantageous and novel structure has been described that overcomes the disadvantages of the prior art. It should also be understood that the materials used in fabricating the invention as herein described are not critical and any material generally considered suitable

for a particular function may be used. For example, a molded rigid vinyl may be used for the plate **31** and its integrally formed arms **71** and frames **75** and **87**. Also, the propeller shaft housing **181** and **181'** and the cowling **17** may be molded from a cellulose acetate or polycarbonate material. Furthermore, any conventional process, such as vacuum and injection molding, may be utilized to form the various structures illustrated. Thus, to facilitate assembly of the portion **25**, the housing may be molded in two longitudinal halves and cemented or otherwise bonded permanently together at the seams, as is well-known in the art.

Although a single embodiment of the invention has been described in detail, it should be realized that modifications and other embodiments incorporating the inventive features may be constructed. Accordingly, it is intended that the foregoing disclosure and drawings shall be considered only as illustration of the principles of this invention.

What is claimed is:

1. A detachable power module for removable attachment to a toy vahicle body, comprising:

a propeller means;

a housing having a free end and an attachment end including body attachment means for removably attaching said housing to said toy vehicle body, wherein said attachment end of said housing includes a wall orthogonal to the axis of rotation of said propeller means, and wherein said attachment means includes an attachment bulkhead mounted on one end of said body, said attachment bulkhead having a resilient holding tab adapted to grip one edge of said wall and having a holding bracket opposite said holding tab and adapted to receive and register with an opposite edge of said wall;

motor means mounted only in said housing for providing power to drive said vehicle; and

drive means disposed in said housing and operatively coupled to said propeller means and to said motor means for transmitting said power to said propeller means.

2. The detachable power module according to claim **1**, wherein said drive means includes a propeller shaft rotatably disposed in said housing and having one end extending beyond said free end of said housing into coupled engagement with said propeller means, said drive means also including a gearing arrangement operatively coupled to and disposed between said motor means and the other end of said propeller shaft.

3. A detachable power module for removable attachment to a toy vehicle body, comprising:

a propeller-shaft housing structure having a circular cross sectioned hollow elongated nose portion with a propeller-facing forward end, and having circular cross sectioned increased diameter hollow rear portion, said rear portion being provided with a plurality of tabs extending radially therefrom; and

a wall having a first face and a second face, L-shaped retaining brackets provided on one of said faces for receiving said tabs on said propeller-shaft housing structure, whereby said housing structure may be connected to said wall, said wall being provided with body attachment means for removable attaching said housing structure to said vehicle body.

4. A detachable power module according to claim **3** wherein said other face of said wall is provided with motor support means for supporting motor means used to drive said vehicle.

5. A detachable power module according to claim **3**, also comprising an elongated propeller shaft rotatably disposed in said housing structure essentially along the major axis thereof and extending beyond said propeller-facing forward end, a shaft-driving gear rotatably mounted in said housing structure perpendicular to and centered along said major axis, said shaft-driving gear having teeth provided around the periphery thereof, and a coupling member attached between the rear end of said propeller shaft and said shaft-driving gear.

6. A detachable power module according to claim **5**, wherein said wall includes an axle-accepting aperture centered at said major axis, said shaft-driving gear also including an axially-extending spacer projecting from the rear surface thereof, said shaft-driving gear further including an axle mounted in said spacer and passing through said axle-accepting aperture in said wall.

7. A detachable power module according to claim **6**, further comprising a propeller with an axial bore and a nose bearing member having an axial bushing portion and a transverse annular washer portion integral therewith, the forward end of said propeller shaft being seated in said axial bore of said propeller, said axial bushing portion of said nose bearing member being disposed in the axial opening in said propeller-facing forward end of said nose portion, and said annular transverse washer portion being disposed between said propeller and said propeller-facing forward end of said nose portion.

8. A detachable power module according to claim **7**, also comprising a motor means mounted on the other face of said wall and having a motor shaft and associated motor pinion extending through an aperture in said wall, said motor pinion registering with said teeth on said shaft-driving gear.

9. A detachable power module according to claim **8**, further comprising a rechargeable battery arrangement, and wherein said wall includes a rearwardly extending frame whereon said battery arrangement is mounted, said battery arrangement being electrically coupled to said motor means.

10. A detachable power module according to claim **9**, wherein said body is a toy aircraft fuselage.

* * * * *