United States Patent [19]

Guttman

[11] **3,857,194**

[45] **Dec. 31, 1974**

[54] **MODEL AUTO-GIRO**

[76] Inventor: **Murray Guttman,** 250 Johnochs Dr., Saddle Brook, N.J. 07662

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[21] Appl. No.: **420,054**

Related U.S. Application Data

[62] Division of Ser. No. 264,269, June 20, 1972, Pat. No. 3,791,067.

[52] **U.S. Cl.** ..... **46/244 B,** 46/75

[51] **Int. Cl.** **A63h 27/12**

[58] **Field of Search** ..... 46/75, 244 B

[56] **References Cited**

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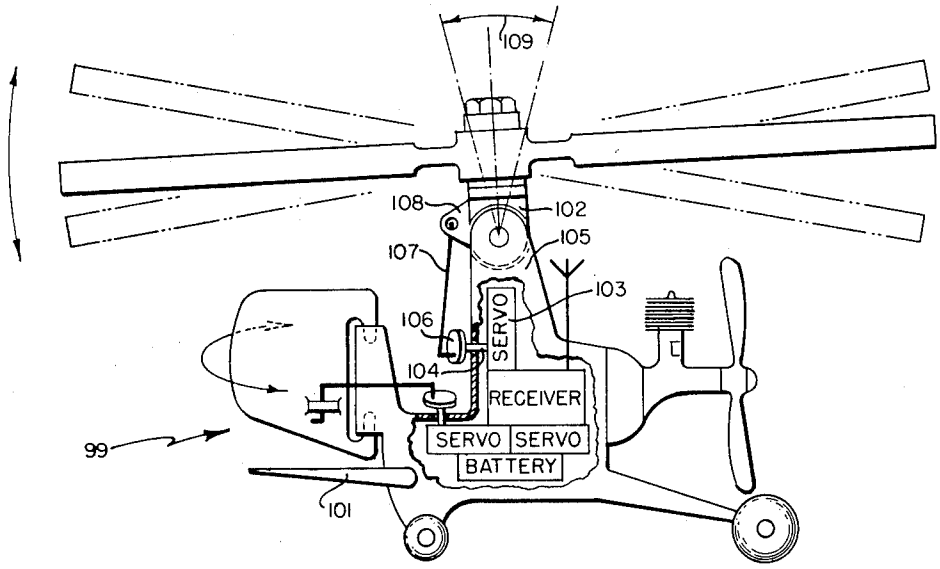
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Primary Examiner—Louis G. Mancene
Assistant Examiner—Robert F. Cutting
Attorney, Agent, or Firm—James J. Cannon, Jr.; James J. Cannon

[57] **ABSTRACT**

Four configurations of a model auto-gyro are disclosed with appropriate methods and means of control for each configuration. Two configurations utilize a pivoting stabilator and a fixed rotor shaft and permit the auto-giro to take off, ascend, loop, descend and land, but do not permit it to hover. Two further configurations utilize a fixed horizontal stabilizer and a tiltable rotor shaft, the combination of which permit the model auto-giro to perform all the flight manoeuvres of the first two configurations and permit it to hover also. Methods and means for controlling each type of configuration by captive control lines and confining them to circular flight paths are disclosed. Methods and means for remotely controlling each type of configuration by radio controls permitting free flight are also disclosed.

4 Claims, 11 Drawing Figures



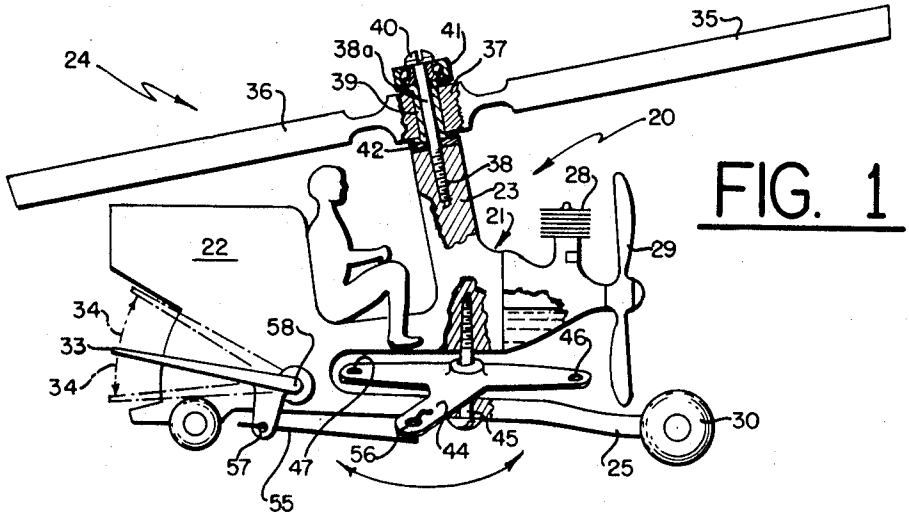


FIG. 1

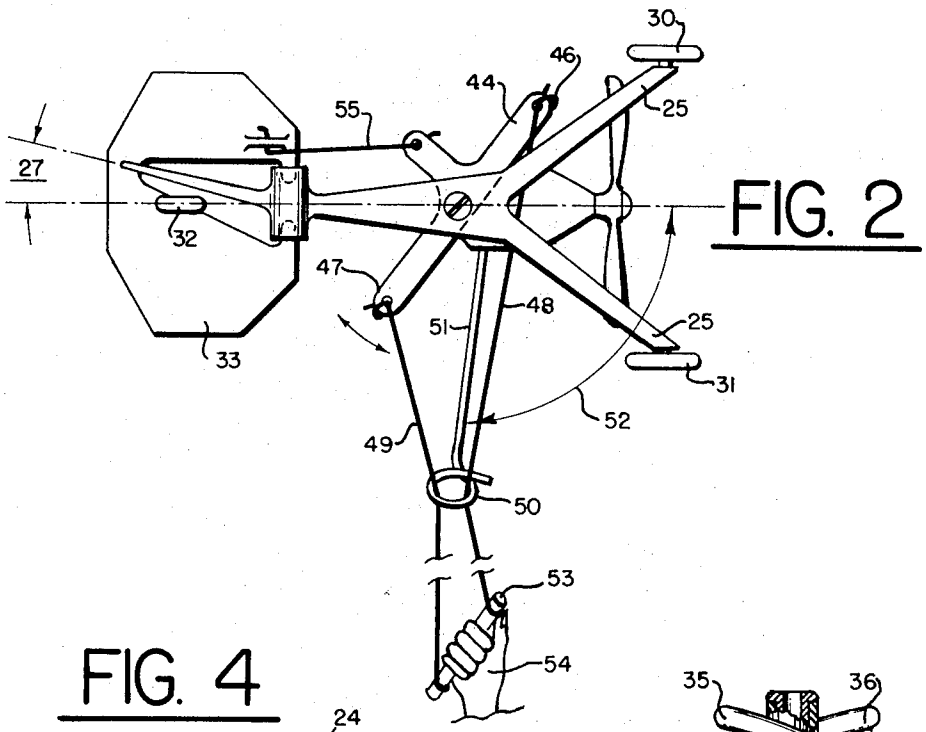


FIG. 2

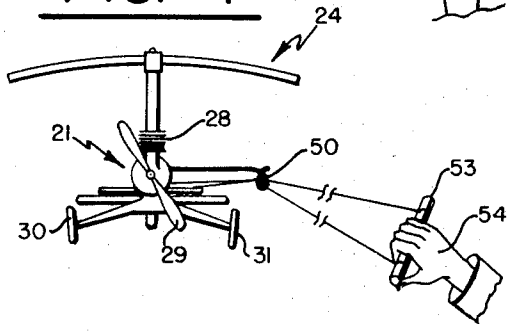


FIG. 4

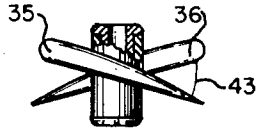


FIG. 3

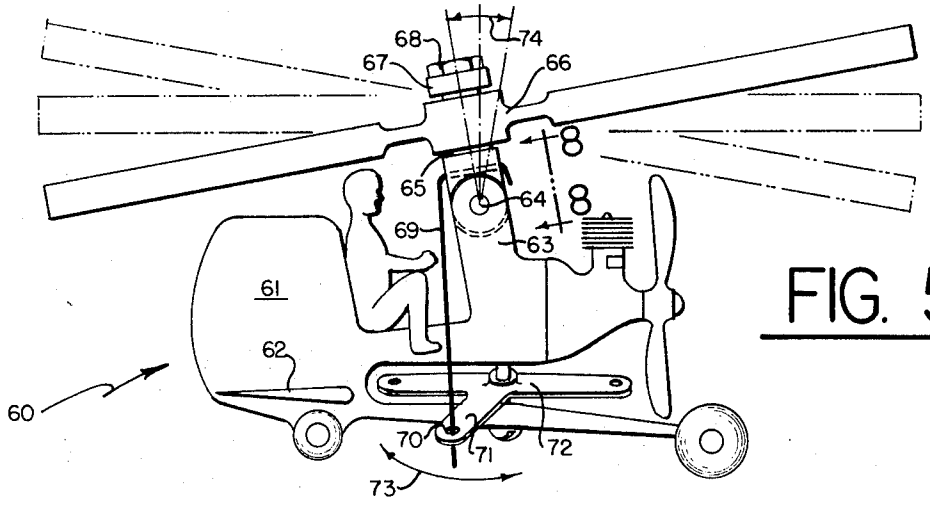


FIG. 5

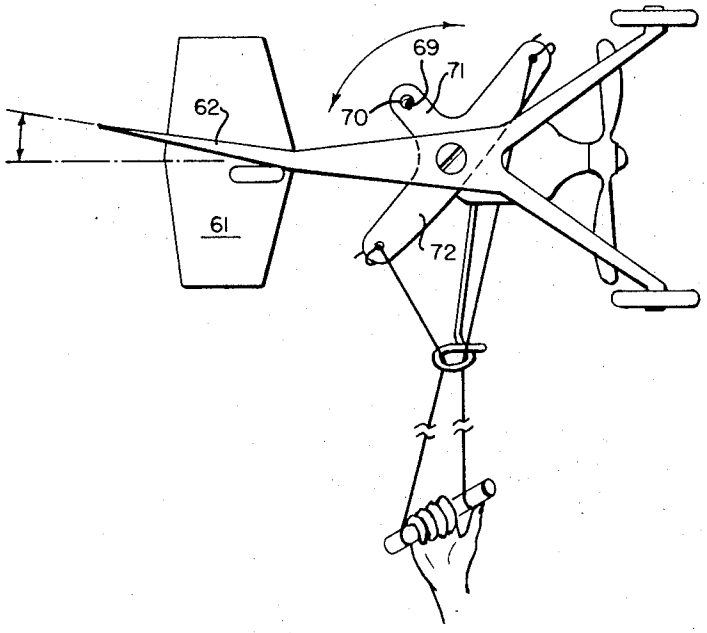


FIG. 6

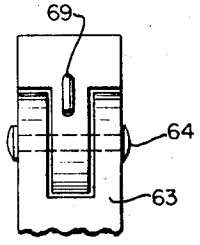


FIG. 8

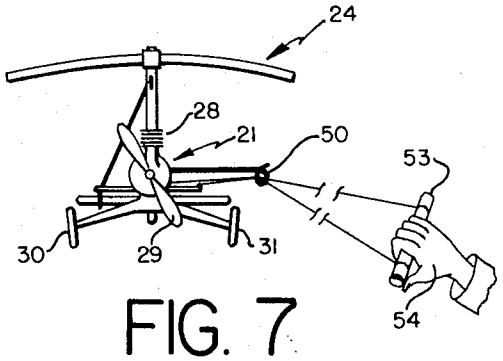


FIG. 7

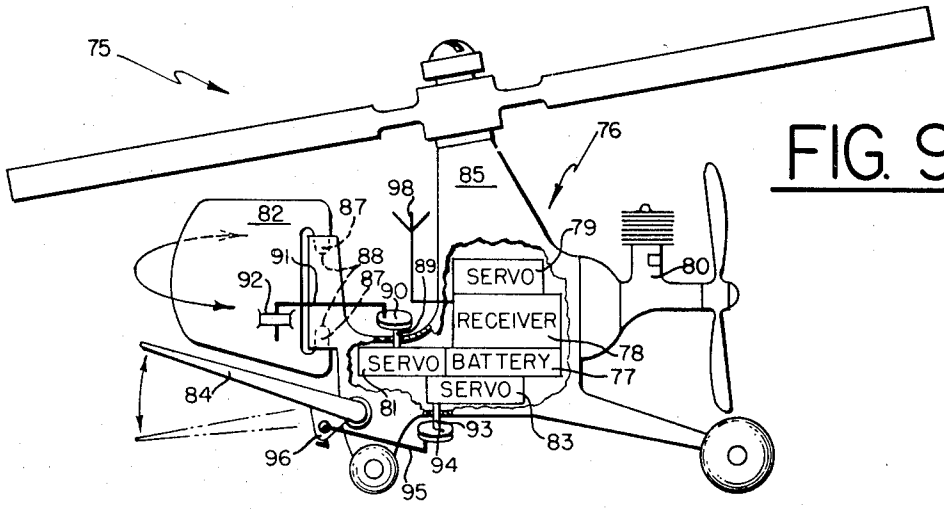


FIG. 9

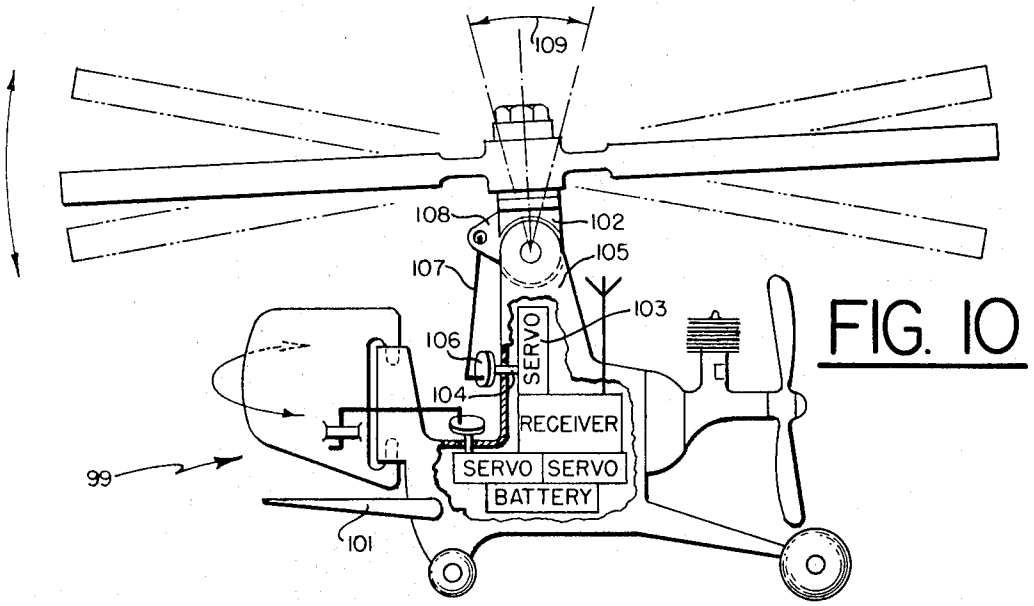


FIG. 10

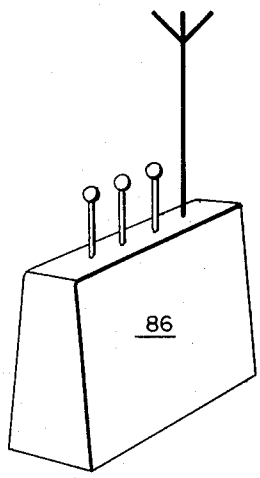


FIG. 11

MODEL AUTO-GIRO

This is a division of application Ser. No. 264,269 filed June 20, 1972, now U.S. Pat. No. 3,791,067.

BACKGROUND OF THE INVENTION

This invention relates to models of rotary wing aircraft and more particularly to models of aircraft capable of both vertical and horizontal flight, commonly known as auto-giros, and methods for controlling said models by means of captive control lines and radio controls to simulate the flight characteristics of an actual auto-giro aircraft.

An auto-giro is a rotary wing aircraft with a free-turning rotor, which is caused to auto-rotate from the flow of air past the rotor when the craft is drawn forward by an engine-driven propeller, as in the case of a conventional airplane.

The prior art discloses numerous patents covering model airplanes and helicopters, and methods of controlling said models. It also discloses several patents, namely U.S. Pat. Nos. 2,110,563; 3,149,802; and 3,588,082; disclosing various types of passenger carrying auto-giros. However, no model auto-giro has been found in the prior art.

The principal design problem for a successful model auto-giro is maintenance of aerodynamic stability in flight, especially at low flight speeds and during hovering. This problem is especially critical for auto-giro models utilizing captive control lines. The use of captive control lines is substantially less expensive than the use of radio controls, but poses significantly greater control problems for the model auto-giro. With captive control lines it is essential that tension be maintained on control lines at all times, especially during slow flight and hovering. The first two configurations disclosed in this specification utilize a number of novel techniques which in combination are able to maintain the required tension. The second two configurations disclosed utilize variations on these techniques adapted to the requirements of radio-controlled operations.

SUMMARY OF THE INVENTION

This invention relates to gasoline-powered model auto-giros and methods for the control of said models in flight. Each model utilizes a gasoline-powered engine mounted on the fuselage driving a propeller to power the model auto-giro. pitch control means are provided to affect changes in altitude and means for controlling the direction of flight are included.

Four alternate configurations of a model auto-giro and four alternate control methods for the configurations are disclosed. The first two methods of control utilize captive control lines, while the second two utilize remote radio-controls. In the first alternate configuration, the auto-giro is controlled by a two line flexible cord held by the operator, confining the auto-giro to a circular flight path. These control lines in turn operate a bellcrank lever connected to a pivoting stabilator. By pivoting his hand, either to the left or right or up or down, the operator can control the attitude of this stabilator and enable the auto-giro to take-off, ascend, descend, loop and land. The second alternate is similar to the first, except that it utilizes a fixed horizontal stabilizer and a tiltable rotor shaft. In this configuration the pivoting of the operator's hand causes the bellcrank lever to engage the tiltable rotor linkage, tilting the rotor shaft forward or rearward. This tilting of the rotor shaft enables the auto-giro to take-off, ascend, loop, descend, land and also hover. This second configuration permits the auto-giro to hover as well as perform all the flight manoeuvres of the first alternate.

The third and forth configurations are similar to the first and second respectively except that these configurations of the model auto-giro are adapted to radio controls, and the control methods permit relatively free flight of the model auto-giro unconfined to a circular flight path, that is, the model auto-giro may fly to the left or right or in any direction within the range of the transmitter signal.

All alternate configurations may be equipped with a throttle control consisting of either an additional control line or an additional radio channel and servo motor. All alternate configurations may also be equipped with additional auxilliary fuel tanks for extended operation.

It is the principal object of this invention to provide a gasoline-powered model auto-giro capable of simulating the flight of full size auto-giros.

It is a further object of this invention to provide a method for the control of a model auto-giro by captive control lines.

It is another object of this invention to provide a method for remotely controlling the operation of a model auto-giro.

It is another object of this invention to provide a model auto-giro of extremely simple construction and very inexpensive to manufacture or build.

It is still a further object of this invention to provide a model auto-giro capable of hovering flight, whether captive or under remote radio control.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features which are believed to be characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in which:

FIG. **1** is a schematic side elevational view of a model auto-giro having captive control lines according to the invention;

FIG. **2** is a schematic bottom view of the auto-giro in FIG. **1**;

FIG. **3** is an enlarged sectional view of a portion of the rotor shaft with rotor blades cut away showing the relative position of the blade mountings;

FIG. **4** is a schematic front view of the auto-giro of FIG. **1**;

FIG. **5** is a schematic front view of an alternate version of the auto-giro of this invention having a tiltable rotor shaft;

FIG. **6** is a schematic bottom view of the auto-giro of FIG. **5**;

FIG. **7** is a schematic front view of the auto-giro of FIG. **5**;

FIG. **8** is a partially cut-away view of a portion of the rotor shaft of the auto-giro of FIG. **5**;

FIG. **9** is a schematic side elevational view of the auto-giro of FIG. **1** modified to show adaptations for radio control.

FIG. 10 is a schematic side elevational view of the auto-giro of FIG. 5 modified to show adaptations for radio controls.

FIG. 11 is a schematic view of an operator radio unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawings, the first configuration of the model auto-giro of this invention is designated **20** in FIG. **1.** The auto-giro **20** comprises a fuselage **21** and integrally formed therewith a rudder **22,** and a rotor mast **23** adapted at its top to receive a rotor **24** and two front wheel extenders **25, 26** or spring wire wheel extenders. Rudder **22** is permanently set at a fixed angle **27** to the fuselage **21,** as illustrated in FIG. **2.** A model gasoline powered internal combustion engine **28** having a puller propeller **29** is mounted on the front of the fuselage **21.** Wheels **30, 31** are mounted on the front wheel extenders **25, 26.** A single small wheel or skid **32** is mounted at the rear of the fuselage. All wheels are driven only by friction created by the forward movement of the auto-giro on the ground. A stabilator **33** is pivotally mounted to the rear of the fuselage, its trailing end pivoting through an arc **34.** The rotor **24,** which may be of one-piece construction, comprising the blades **35, 36,** connected to a circular hub **37,** is rotably mounted on top of rotor mast **23,** and held in position by a retaining screw **38** whose elongated shank serves as a rotor shaft **38***a* and whose head **40** serves as a retainer. A thin-walled tubular bearing **39** is placed within hub **37** to reduce wear on the hub. Utilizing the screws head **40** a thrust bearing **41** may be inserted between the hub **37** of the rotor **24** and the screw head **40** to reduce friction and permit rotor **24** to spin at its maximum speed. A washer **42** is inserted between the hub **37** of the rotor **24** and the mast **23** to reduce wear. Rotor blades **35, 36** are pitched at a slightly different angle from one another and have an airfoil section as illustrated in the end view of FIG. **3.** Foil angle **43** is designed to allow a counterclockwise direction of rotation from the airflow the rotor catches when viewed from above from the center of the circle of flight. Thus the rotor **24** gets more lift from blade **35** than from blade **36.** The angular relationship between blades may vary to suit various air foil designs, some of which may eliminate foil angle **43.** Rotor blades **35, 36** are positioned such that the leading edge of blade **35,** which provides greater lift than blade **36,** is inward toward the operator. Lift side **35** is used to benefit control line **48, 49** tension during normal flight by tilting auto-giro slightly outward from the operator.

Propeller **29** is a left-handed propeller in the configuration illustrated in FIG. **4,** rotating in a clockwise direction, to increase still further the tension on control lines **48, 49.** The combined effects of the position of rudder **22,** lift blade **35,** left-handed propeller **29,** position of looped eye **50** (later to be described), the position of stabilator **33** and the size and location of bellcrank lever **44** cause the model auto-giro **20** to lean slightly toward the outside of the circular flight path at all speeds and in all flight manoeuvres, thus maintaining tension on the control lines **48, 49** at all times.

The control line system comprises a bellcrank lever **44** pivotally mounted at its center to the bottom of fuselage **21** immediately below rotor mast **23** as close to the center of gravity as possiblee and held in position by a mounting screw **45** whose shank serves as its shaft. Connected to the two in-lines **46, 47** of the bellcrank lever **44** are two flexible lines **48, 49.** A looped eye **50** on a short wire shaft **51** is fixably mounted to fuselage **21** extending from one side thereof from the approximate center of gravity. Lines **48, 49** pass through looped eye **50** to prevent them from becoming entangled in the propeller **29** and rotor **24.** Eye **50** is positioned so that when lines **48, 49** pass through it, their normal angle **52** to the longitudinal axis of the fuselage is slightly obtuse, ans shown in FIG. **2,** to create more tension in lines **48, 49.** Lines **48, 49** terminate at two ends of bar **53** which is held in the hand **54** of the operator. A rigid wire line **55** connects the bellcrank lever **44** at branch **56** to a downward projecting tab **57** on stabilator **33,** which is pivotally connected to fuselage **21** at point **58,** the raising or lowering of the stabilator being controlled by the pivoting of bellcrank lever **44.** As illustrated in FIG. **1,** stabilator **33** is located at the approximate center line of the air slip stream created by drive propeller **29.** Rudder **22** is rigidly placed at fixed angle **27** to insure outward force away from the operator to maintain tension on control lines **48** and **49** when speed of auto-giro **20** is minimal. The length of lines **48, 49** becomes the radius of the circular flight path of auto-giro **20,** and varying the length of said lines will vary that radius. By a pivoting action of a bar **53** when lines **48, 49** are taut, the operator is able to cause a bellcrank lever **44** to pivot, thereby pivoting the trailing edge of the stabilator edge **33** through arc **24** to control the pitch of the auto-giro **20.**

The first configuration described above operates on captive control lines **48, 49** which are manipulated by an operator holding bar **53.** This model is confined to a circular path whose radius is the length of lines **48, 49.** The model is operated by placing it on the ground and, with the assistance of an operator's helper, starting the engine **28,** which drives the propeller **29.** With the engine operating, the helper releases the model auto-giro **20** which will start to roll along the ground. The flow of air now rushing past rotor blades **35, 36** causes rotor **24** to autogirate freely. As the flow of air past airfoils **35, 36** increases in velocity, the auto-giro **20** commences to lift off the ground, the lift provided primarily by airfoils **35** and **36.** By pivoting bar **53** the operator can pull line **46** while releasing tension on line **48.** This action rotates bellcrank lever **44** such that rigid link **55** connected to tab **57** on stabilizer **33** is pushed backwards causing the trailing edge of stabilator **33** to be raised to a take-off position. After take-off the tension is equilized on the lines to permit the stabilator to return to a roughly horizontal position for level flight. In this configuration, the auto-giro can ascend, descend, loop, land and take off again. The auto-giro will glide and land safely if the fuel supply is exhausted or the engine fails. A third control line can be added to control the engine throttle for increase or decrease of speed. While this configuration is able to move up and down by utilization of a pivoting stabilator, it cannot hover.

An altenate configuration described in this paragraph will enable auto-giro **60** to hover. The modification required for hovering embraces a fixed horizontal stabilizer and a tiltable rotor as described hereafter. With reference to FIG. **5,** the auto-giro **60** has a rudder **62** similar to rudder **22** of FIG. **1,** but increased in size, and horizontal stabilizer **61** is rigidly attached thereto so that the slip stream of drive propeller **29** is approxi-

mately parallel to stabilizer **61.** Rotor mast **63** contains pivoting linkage **64** connecting it to a rotor shaft **65** which is adapted to receive rotor **66** similar to rotor **24** of FIG. **1.** Rotor **66** is held in position by a thrust bearing **67** and nut **68.** An L-shaped rigid wire link **69** is inserted and secured in the lower portion of rotor shaft **65** and extends vertically downward to and through a hole **70** in branch **71** of bellcrank lever **72** where it is allowed to float freely. The pivoting action of control bar **53** causes bellcrank lever **72** to pivot branch **71** through an arc **73** forcing rigid link **69** to cause rotor shaft **65** to pivot through arc **74,** thereby tilting rotor **66.** This tilting action enables auto-giro **60** to hover as well as perform all other flight manoeuvres of the first configuration, though still confined to a circular flight path as defined by the length of control lines **48, 49.**

Both configurations of the model auto-giro disclosed above may be modified to utilize remote radio controls. The third configuration, illustrated in FIG. **9,** is essentially similar to the first configuration, illustrated in FIG. **1,** except for the modifications necessary for radio control. The general construction of the third configuration including the pivoting stabilator and nontiltable rotor shaft as illustrated in FIGS. **1, 2** and **3** with the modifications shown in FIG. **9.** All components related to captive line control, such as bellcrank lever **44,** loop eye **50,** loop eye shaft **51,** control lines **48, 49,** operator bar **53,** as shown in the configuration of FIG. **1** are eliminated from the configuration of FIG. **9.** As shown in FIG. **9,** auto-giro **75** has a fuselage **76** which is modified to accept radio control components comprising a battery **77,** a multi-channel receiver **78,** a servo-motor **79** to operate the throttle (not shown) of engine **80,** a servo-motor **81** to operate a pivoting rudder **82,** and a servo-motor **83** to operate pivoting stabilator **84.** All these control units are located in the fuselage **76** near or under rotor mast **85** to counter-balance the weight of engine **80.** The auto-giro **75** is controlled by a multichannel transmitter **86,** shown in FIG. **11.**

In this third configuration, auto-giro **75** has a pivoting rudder **82** constructed as a separate part and hinged at the upper rear of fuselage **76** by means of two inwardly projecting tips **87.** The upper rear of fuselage **76** contains two recesses **88** to receive tips **87.** Servo-motor **81** drives a shaft **89** which extends outward through the bottom of the fuselage and on which is mounted a rotating disk **90.** Disk **90** is connected by a rigid wire link **91** to rudder **82** and inserted in slot **92** on rudder **82.** Pivoting disk **90** over an arc of approximately 120° causes a rudder **82** to pivot over a corresponding arc. Servo motor **83** drives a shaft **93** which extends outward through the fuselage and on which is mounted a rotating disk **94.** Disk **94** is connected by rigid wire link **95** to tab **96** which projects downward from the leading edge of stabilator **84** to pivot the stabilator **84** up or down through arc **97.** An antenna **98** is attached to fuselage **76** for reception of radio signals from transmitter **86.**

This third configuration illustrated in FIG. **9** and described in the preceding paragraph can perform all flight manoeuvres except hovering, but is not constrained to a circular flight path as was the first configuration.

The fourth configuration, illustrated in FIG. **10,** is essentially similar to the second configuration, illustrated in FIG. **5** except for the modifications necessary for radio control in which respect it is similar to the third configuration illustrated in FIG. **9.** The general construction of the fourth configuration, including the fixed horizontal stabilizer and the tiltable rotor shaft is illustrated in FIGS. **5, 6** and **7** with the modifications shown in FIG. **10.** All components related to captive line control such as bellcrank lever **72,** loop eye **50,** loop eye shaft **51,** lines **48, 49** and operator bar **53,** as shown in the configuration of FIG. **5** are eliminated form the configuration of FIG. **10.** As shown in FIG. **10,** auto-giro **99** has a fuselage **100** which is modified to accept radio control components similar to the third configuration. The fourth configuration, however, has a fixed horizontal stabilizer **101** and does not require the stabilator controls shown in FIG. **9.** This configuration has a tiltable rotor shaft **102** similar to that of the second configuration as illustrated in FIG. **5.** A servo motor **102** drives a shaft **104** extending through the side of rotor mast **105** to which a rotating disk **106** is attached. Disk **106** is connected by a rigid wire link **107** to a tab **108** projecting rearwardly from rotor shaft **102** and attached thereto. Rotation of disk **106** causes link **107** to tilt shaft **102** through arc **109.** This design has a rudder actuator similar to that of the third configuration illustrated in FIGS. **9** and **10.** This configuration is able to perform all the flight manoeuvres of the third configuration and is also capable of hovering.

Further variations in the configurations described above and in their methods of control are possible. The gasoline powered engine could be mounted behind the rotor shaft and equipped with a pusher propeller. Additional auxiliary fuel tanks could be provided for extended flight. Throttle controls may be installed on the first two configurations. A model pilot and pilot seat may be installed with its location dependent on the location of the engine.

While only certain embodiments of this invention have been shown and described by way of illustration, many modifications within the true spirit and scope of this invention and within the following claims will occur to those skilled in the art.

I claim:

1. In a model rotary wing aircraft comprising:

a fuselage;

an operable engine means mounted on said fuselage along the longitudinal axis of the fuselage;

a propeller mounted on said engine means, said engine and propeller enabling the forward driving of said aircraft as an autogiro for take-off, landing or normal translational flight;

a general upwardly extending vertical rotor mast mounted on said fuselage and adapted to receive a rotor;

a free spinning rotor mounted on said mast having a plurality of rotor blades extending outwardly and generally horizontally from said mast; the rotor being disposed in the path of the air flow from the propeller;

landing gear mounted on said fuselage;

radio control means for providing aerodynamic control in various flight attitudes of said model rotary wing aircraft;

2. In a model rotary wing aircraft comprising:

a fuslage;

an operable engine means mounted on said fuselage along the longitudinal axis of the fuselage;

a propeller mounted on said engine means, said engine and propeller enabling the forward driving of

said aircraft as an auto-giro for take-off, landing or normal translational flight;

a generally upwardly extending vertical rotor mast mounted on said fuselage, adapted for limited, tilting action, at least in a plane fore and aft of said aircraft, and adapted to receive a rotor on its upper, tiltable end;

a free spinning rotor mounted on said mast having a plurality of rotor blades extending outwardly and generally horizontally from said mast; the rotor being disposed in the path of the air flow from the propeller;

landing gear mounted on said fuselage;

radio control means of providing operator control of the flight of said model rotary wing aircraft.

3. The apparatus of claim **1** wherein said radio control means further comprises:

a radio transmitter for sending operator control signals to said model aircraft;

a radio receiver mounted in the fuselage of said model aircraft for receiving said control signals from said transmitter;

a rudder pivotally attached to said fuselage;

a first servo motor responsive to said receiver mounted in the fuselage of said aircraft for controlling the pivoting movement of said rudder;

a stabilator pivotally attached to the rear of said fuselage;

a second servo motor responsive to said receiver mounted in the fuselage of said aircraft for controlling the pivoting movement of said stabilator; and

a battery mounted in said fuselage for supplying electrical power to said receiver and said servo motors.

4. The apparatus of claim **2** wherein said radio control means further comprises:

a radio receiver mounted in the fuselage of said model aircraft for receiving said control signals from said transmitter;

a rudder pivotally attached to said fuselage;

a first servo motor responsive to said receiver mounted in the fuselage of said aircraft for controlling the pivoting movement of said rudder;

a throttle for controlling the speed of said engine;

a second servo motor responsive to said receiver mounted in the fuselage of said aircraft for controlling the adjustment of said throttle; and

a third servo motot responsive to said receiver mounted in the fuselage of said aircraft for controlling the tilting movement of said rotor mast.

* * * * *