

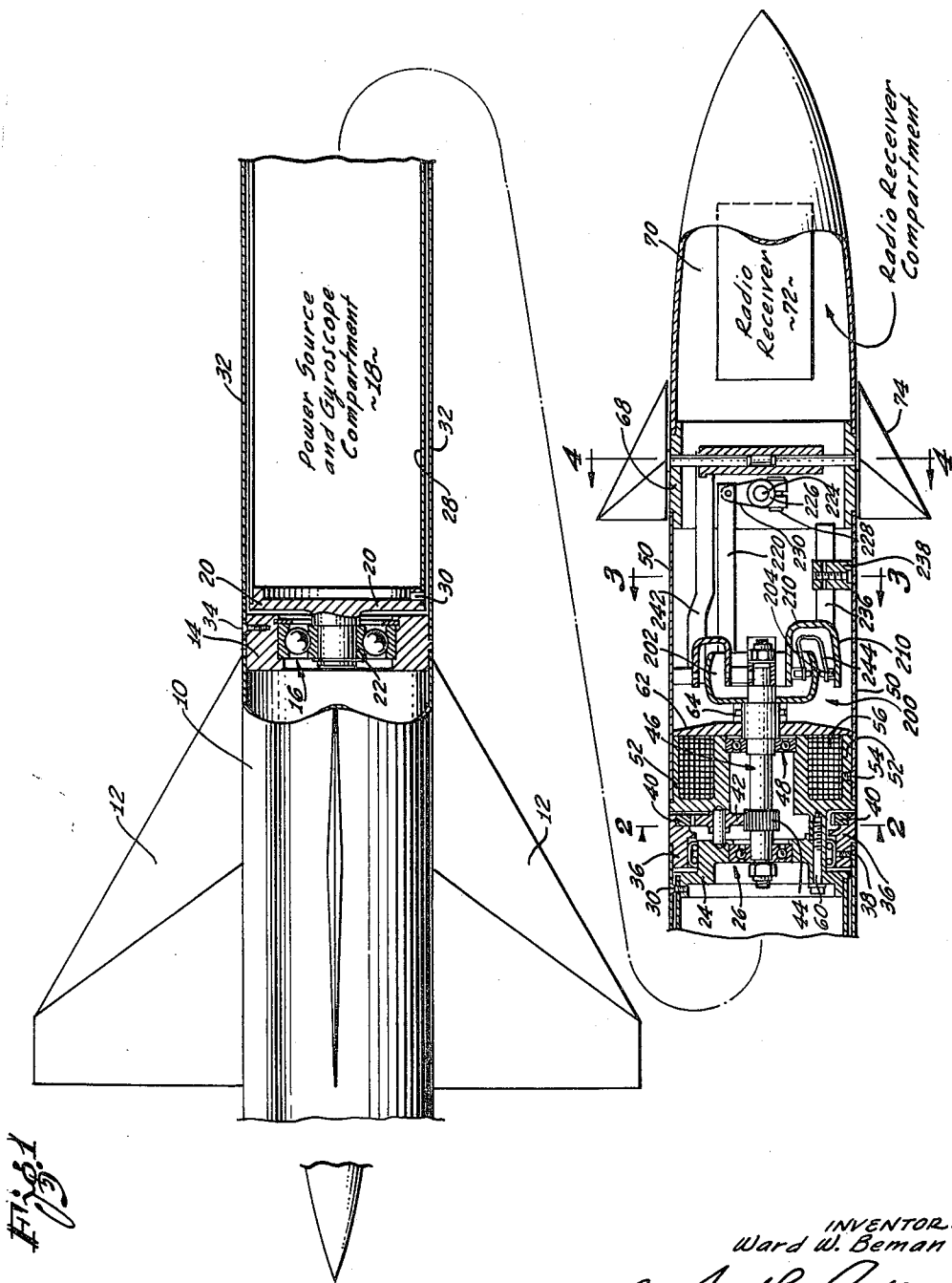
Dec. 11, 1962

W. W. BEMAN
GUIDED MISSILE

3,067,681

Filed Jan. 4, 1960

2 Sheets-Sheet 1



INVENTOR:
Ward W. Beman
By *Amuth & Costen*
Attorneys

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2 Sheets-Sheet 2

Fig. 2

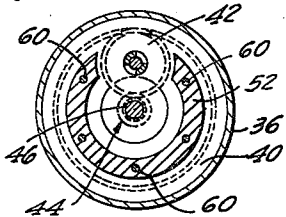


Fig. 3

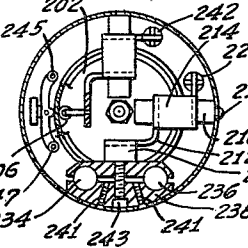


Fig. 4

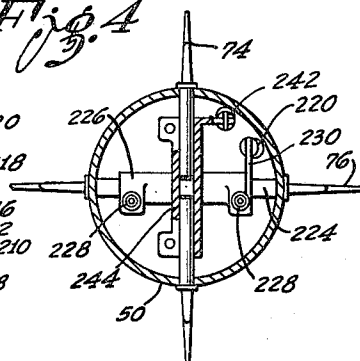


Fig. 5

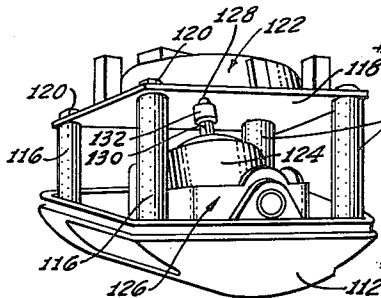


Fig. 6

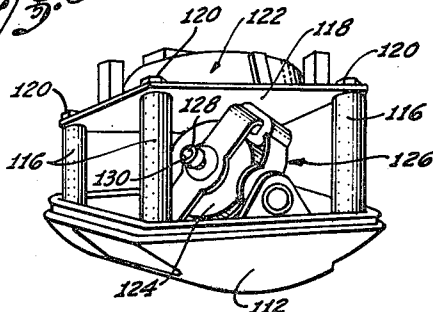


Fig. 7

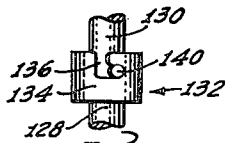
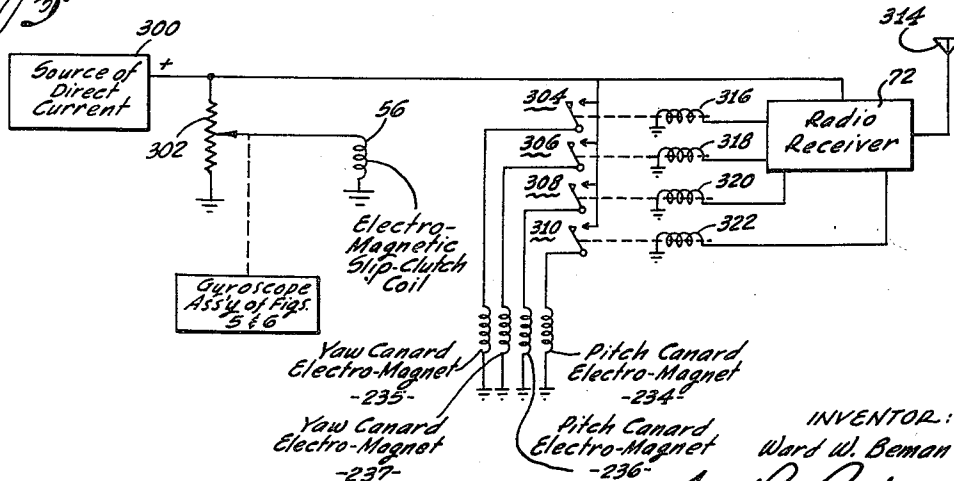


Fig. 8



INVENTOR:

Ward W. Beman

By Amythe Roaton
Attorneys.

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3,067,681

GUIDED MISSILE

Ward W. Beman, Newport Beach, Calif., assignor to
Telecomputing Corporation, Los Angeles, Calif., a cor-
poration of California

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5 Claims. (Cl. 102-49)

The present invention relates to guided missiles, and it relates more particularly to an improved guided missile which is relatively inexpensive to construct. The missile of the present invention is ideal for training purposes. However, it may be constructed to incorporate a war head for combat uses, when so desired.

In the training of combat personnel, it has been found that the value of the training is much greater when actual weapon operation is simulated during the training exercises. The problem of cost has arisen, however, in the training of personnel in the use of guided missiles. It is apparent that the high cost of present day guided missiles renders the extensive use of such missiles for training purposes prohibitive and impractical.

The problem outlined in the preceding paragraph can be overcome by the use of a low cost missile which has performance characteristics as close as possible to the characteristics of the high-cost missiles which are used in actual combat. The missile of the present invention is ideal for that purpose. The missile of the invention is inexpensive in cost, reliable in operation, and simple to operate and maintain. These are some of the reasons which render the missile of the invention ideal for practical training purposes. However, it should be reiterated that the guided missile of the invention is also useful in combat; and for any operation which requires a reliable, rugged and inexpensive vehicle.

It is an important object of the present invention to provide a guided missile which answers the criteria set out in the preceding paragraph. A further object of the invention is to provide an improved guided missile which is ideal for training purposes; or for any purpose for which a low cost, reliable and simple missile may be required.

The improved missile of the present invention requires no warming up operations prior to launching, and the missile is relatively small so that no major storage problems arise. Although the missile of the invention is relatively small, as compared with other types of present day guided missiles, the missile of the invention is capable of providing a realistic simulation of the flight of other, larger and more expensive missiles. Moreover, the missile of the invention is capable of achieving speeds comparable with the speeds of the larger and more expensive missiles, and the missile of the invention is capable of providing similar response to guidance commands as the response of the other types of present day missiles.

The embodiment of the improved guided missile to be described incorporates a unique and improved mechanism for providing roll stabilization of the guidance and control equipment in the missile, and this is achieved by relatively simple equipment which requires a minimum of component parts.

The guided missile of the invention, insofar as the embodiment to be described is concerned, is radio controlled by way of commands originating, for example, at the launching vehicle. The operator at the launching vehicle transmits corrective commands to the missile over a radio link, these commands being based on the observation by the operator of the flight path of the missile and of the target, and which commands correspond to any necessary deviations in the flight path of the missile to keep it on a collision course with respect to the target.

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The after section of the embodiment of the invention to be described is embodied in a slow spin cruciform of unique construction. The nose section, however, maintains a stationary roll attitude by means of a plurality of differential offset canards, whose action will be described in detail and which are attached to the nose section of the missile.

The after section of the missile includes usual fins for imparting the slow spin to that section. A rocket motor is included in the after section. A coupling between the spinning after section and the stationary nose section is included to supply mechanical power to the canards on the nose section for stabilizing purposes. The canards are further controlled, however, by use of a slant wheel mechanism, which also will be described in detail. The rocket motor for the missile may, for example, be a 5 inch solid propellant type having a thrust of approximately 250 pounds, the specific impulse of the fuel being approximately 210 seconds. The rocket motor itself forms no part of the invention, and any suitable known type may be used.

A reference for the fixed roll attitude nose section of the missile of the invention is supplied by a spring energized free gyro. This gyro is contained in a gyroscope compartment in the non-spinning after section of the missile.

A radio receiver is mounted in the missile to receive command signals from the launching vehicle. Electric power for the radio receiver is supplied, for example, by a direct current generator or by appropriate batteries. This generator may conveniently be located in the gyroscope compartment in the non-spinning after section of the missile.

It is usual at present for the command transmitter at the launching vehicle to transmit the command signals in the 200-400 megacycle band. The radio receiver of the missile is designed, therefore, to select a predetermined frequency in that band and to demodulate the received signals so as to obtain correction signals for the pitch and yaw attitudes of the missile. In the embodiment of the invention to be described, the corrective signals are caused to operate relays which, in turn, cause the corresponding canards to assume hard-over positions for controlled periods of time.

The radio receiver to be used in the missile of the invention is designed, for example, to fit into a radio receiver compartment in the nose section of the missile. The weight of a typical suitable receiver is of the order of 1½ pounds. The receiver itself may, for example, be of the superheterodyne or super-regenerative type, and it is preferably transistorized.

In brief, therefore, the improved guided missile of the invention is simple in its design and construction, and it utilizes a minimum of components. This results in a simple, low cost, high productivity missile which is ideally suited for training purposes. The missile to be described is designed to be air launched, and it is an air-to-ground type. The missile may be controlled or maneuvered within certain limits, as mentioned above, by means of suitable commands transmitted to its radio receiver from a transmitter in the launching vehicle.

Further features and advantages of the invention will become apparent from a consideration of the following specification, when taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a side elevational view, partly in section, of a guided missile incorporating the concepts of one embodiment of the invention, this view illustrating the means whereby the different sections of the missile are mounted for relative rotation with respect to one another, and the different compartments and control components which are included in the missile;

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FIGURE 2 is a cross-sectional view, substantially on the line 2—2 of FIGURE 1, this latter view illustrating a gear linkage between a rotating component of the missile and a shaft which is driven by that component for control purposes;

FIGURE 3 is a sectional view, substantially on the line 3—3 of FIGURE 1, and illustrating the various components which make up a "slang wheel" control unit which is used to control a plurality of canards which are mounted on the nose section of the missile;

FIGURE 4 is a cross-sectional view, substantially on the line 4—4 of FIGURE 1, this latter view illustrating the disposition of the canards, and the means by which they are rotatably mounted on the nose section of the missile to control the pitch and yaw of the missile;

FIGURE 5 is a side elevational perspective view of a gyroscope which may be incorporated in the missile so as to maintain a particular roll attitude, this view showing a gimbal-supported gyroscopic inertial mass which is coupled through a releasable coupling to a spring-type drive motor, the inertial mass being held in a caged condition by the coupling in the view of FIGURE 5;

FIGURE 6 is a side elevational perspective view, similar to the view of FIGURE 2, but illustrating the gyroscopic mass after decoupling from the spring drive motor and after its speed has run down;

FIGURE 7 is a fragmentary view showing the releasable coupling between the drive motor and the inertial mass of the gyroscope; and

FIGURE 8 is an electric circuit diagram of the control system of the missile assembly.

The guided missile of the invention, as illustrated in FIGURE 1, for example, includes an essentially cylindrical after section 10 for housing a rocket motor. As noted previously, the rocket motor may be a 5 inch solid propellant type, having a thrust of the order of 250 pounds.

The after section 10 supports a plurality of fins 12 of usual configuration, and this section is caused to spin about the longitudinal axis of the missile by providing, for example, a 2° angle of incidence to the fins. As noted above, the spin rate of the after section 10 may be of the order of 1–4 cycles per second.

An annular member 14 is mounted at the forward end of the after section 10, and the annular member is supported on the outer race of a bearing 16. The annular member 14 and bearing 16 are supported in coaxial relationship with the axis of rotation of the after section 10.

A cylindrical shaped compartment for a power source and gyroscope is designated 18, and this compartment is positioned in coaxial relationship with the after section 10. The compartment 18, as will be described, does not rotate. This compartment has an end wall 20 which has a shaft portion 22 extending into the bearing 16. The bearing 16 supports the compartment 18 in a manner to permit the compartment to maintain a constant roll attitude as the after section 10 spins.

As noted, the compartment 18 serves to house a spring energized free gyroscope which will be described in more detail subsequently and which may be similar to the gyroscope described in the copending application Serial No. 91,619, filed Feb. 6, 1959, in the name of William E. Bennett, now Patent No. 2,982,140. As also noted, the compartment 18 may include a direct current generator to supply electric power for the radio receiver which is carried in the missile, or batteries may be housed in the compartment for this purpose.

The compartment 18 has a forward wall 24 which is mounted on the outer race of a bearing 26. The compartment 18 also has a cylindrical side wall 28 which is secured to the end walls by screws, such as the screws 30. A cylindrical sleeve 32 is mounted in nested coaxial relationship with the cylindrical side wall 28 of the compartment 18. The cylindrical sleeve 32 is fastened at its forward end to the annular member 14 by a plurality of screws, such as the screw 34. This enables the sleeve 32 to spin

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with the after section 10, the sleeve spinning about the stationary compartment 18.

The forward end of the sleeve 32 is attached to an annular member 36 by means of screws, such as the screw 38. The annular member 36 is supported by the sleeve 32 in coaxial relationship with the axis of rotation of the sleeve. An annular groove is formed in the forward end of the annular member 36, and a ring gear 40 is mounted in the groove to be rotated by the sleeve 32. The ring gear 40 has inwardly extending teeth, and these teeth engage an idler gear 42. The gear 42 is rotatably mounted on the end wall 24 of the non-rotating compartment 18, and this gear engages a pinion gear 44. The latter gear is mounted on a centrally located drive shaft 46.

The drive shaft 46 is rotatably supported by the bearing 26 and by a further bearing 48. The drive shaft 46 extends along the axis of rotation of the sleeve 32, and as the sleeve rotates, the drive shaft is driven through the ring gear 40, and through the idler gear 42 and the gear 44.

The guided missile of FIGURE 1 also includes a forward section 50 which maintains a fixed roll attitude which in the present instance is a fixed or non-rotating condition. The after end of the forward section 50 is affixed to a cylindrical shaped housing 52 by means of screws, such as the screw 54. The cylindrical shaped housing 52 is part of an electromagnetic slip clutch assembly, and it houses the coil 56 of the clutch. The cylindrical shaped housing 52 cooperates with the forward end wall 24 of the compartment 18 in rotatably supporting the idler gear 42.

The housing 52 is secured to the forward end wall 24 of the compartment 18 by means of a plurality of bolts 60 (see also FIGURE 2). These bolts extend through the forward end wall 24 and are threaded into the wall of the housing 52. A clutch plate 62 is keyed to the shaft 46 by means of the pin 64, and the clutch plate extends across the forward end of the housing 52. The housing 52 and the clutch plate 62 are composed of magnetic material. The housing 52 has a toroidal shape, as illustrated, and it has the illustrated configuration so that the clutch plate 62 may serve to complete the magnetic circuit for the magnetic field which is established when the coil 56 is energized.

The construction of the magnetic slip clutch 62 is such that the amount of electric current flowing in the coil 52 determines the amount of drag torque to be exerted by the clutch plate 62 on the housing 52. This, in turn, determines the torque exerted by the drive shaft 46 on the forward section 50 of the missile. The slip clutch assembly is provided to enable corrective torques to be applied to the forward missile section 50. The clutch is operated directly by electric currents derived from a potentiometer on the gyroscope in the compartment 18. In this manner, the electric current from the potentiometer controls the amount of drag torque experienced by the clutch plate 62.

The constant roll attitude forward compartment 50 is attached at its forward end to a cylindrical member 68. This cylindrical member is, in turn, fastened to a nose section which also maintains a constant roll attitude. The nose section provides a compartment for a radio receiver, the receiver being represented by the block 72. As mentioned above, this radio receiver may be of any appropriate type which serves to receive and detect command signals from a command transmitter situated at the launching vehicle.

The fixed roll attitude cylindrical member 68 supports rotatably mounted yaw and pitch canards 74 and 76. These canards are controllable in a manner to be described to cause the missile to execute yaw and pitch maneuvers.

Therefore, when the missile is airborne, the after section 10 is caused to spin by the fins 12. The bearing 16 permits the after section to spin relative to the sections

of the missile which have a fixed roll attitude. A torque from the spinning after section 10 is transmitted to the drive shaft 46 in the manner described. Proper operation of the control system requires that the angular orientation of the forward section 50, of the cylindrical member 68 and of the nose section 70 does not change with respect to a preset initial roll attitude. To achieve this, a two degree of freedom gyroscope (to be described) is mounted in the compartment 18. The outer gimbal axis of the gyroscope is directed along the axis of spin of the after section of the missile. It is apparent, however, that when the gyroscope is mounted in the manner described immediately above with the gyro frame attached to the side wall 28 of the non-spinning compartment 18; relative angular motion of the forward section 50 (which is attached to the forward wall 24 of the compartment 18 through the clutch housing 52 to which it is attached by the screws 54, and through the screws 60) from its initial orientation is detected by relative motion of the gyroscope frame and the gyroscope outer gimbal. The gyroscope may include an appropriate potentiometer pick-off which develops a pick-off signal, and this relative motion causes a characteristic of the pick-off signal to change correspondingly. The pick-off signal is applied to the coil 52 of the electromagnetic slip clutch to apply corrective torques to the forward section 50 from the rotating drive shaft 46 so as to maintain the forward section at a fixed angular position.

The canards 74 and 76 are set to impart a reaction torque to the forward section opposite to the direction of rotation of the after section. Then, the electromagnetic slip clutch assembly is controlled by the gyroscope to provide just enough torque from the drive shaft 46 to oppose any tendency of the forward section to rotate in the opposite direction from the after section due to the reaction torques from the canards. Any such counter rotation of the forward section, causes the gyroscope in the stationary compartment 18 to react and to apply a corrective signal to the slip clutch assembly so that such counter rotation is opposed. The net result is that the gyroscope in the compartment 18 functions to control the forward section of the missile so as to hold that section at a fixed pre-set roll attitude.

A suitable gyroscope for mounting in the stationary compartment 18 is illustrated, for example, in FIGURES 5 and 6. As noted above, this gyroscope may be similar to that described in the copending application 791,619, or any other appropriate gyroscope may be used. The constructional details of the gyroscope itself form no part of the present invention, and for that reason a brief description only will be contained herein of the gyroscope assembly. For a more detailed description of the assembly, reference is made to the above-mentioned copending application.

As shown in FIGURES 5 and 6, the base portion 112 of the gyroscope assembly has a rectangular configuration, and it supports four ports 116 which extend upwardly from its four corners. A mounting plate 118 is supported by the posts 116, and the mounting plate is secured to the posts by a plurality of screws 120. The mounting plate 118 is supported in spaced relationship with the plane of the base portion 112. A spring motor 122 is supported on the top side of the mounting plate 118. An inertial mass 124 is rotatably mounted in a gimbal structure 126, the gimbal structure being supported by the base portion 112, and the inertial mass being rotatably supported in the gimbal structure between the mounting plate 118 and the base portion 112.

The spring-energized drive motor 122 is mounted in co-axial relationship with the axis of rotation of the inertial mass 124 when the mass is driven by the spring motor. The drive motor has a spindle 128 which extends from it along the initial axis of rotation of the inertial mass 124, and the mass 124 has a drive shaft 130 which

extends in axial relationship with the spindle 128 during the initial conditions of the gyroscope assembly.

A coupling 132 releasably couples the spindle 128 to the drive shaft 130. As shown in FIGURE 7, the spindle 128 has a collar 134 formed at its end, and a helical slot 136 is formed in the collar. The end of the drive shaft 130 extends into the collar 136, and that end of the drive shaft has a radial pin 140 extending through it to engage the helical slot 136.

The elements 134, 136 and 140 form the releasable coupler 132. So long as the rotational speed of the spindle 128 from the spring motor 22 exceeds the speed of the shaft 130 of the inertial mass 124, the pin 140 remains in the slot 136 so that a drive torque is transmitted from the spindle 128 to the shaft 130. However, when the drive motor runs down and its speed drops below the speed of the inertial mass, the drive shaft 130 causes its pin 140 to move out of the helical slot. As the pin moves out of the slot, it moves the two shafts 130 and 128 axially apart. The shaft 128 is axially movable along the axis of rotation, so that such disengagement causes that shaft to move back into the spring motor 122.

The spring motor 122 initially holds the inertial mass 124 about a predetermined axis of rotation within its gimbal structure 126. The inertial mass 124 is therefore initially caged and held in a checked position with respect to the frame until released. The spring motor 122 may be in a wound condition, when the assembly is in the condition illustrated in FIGURE 5. Then, the release of the spring motor 122 causes it to impart an accelerating torque to the inertial mass 124 causing the mass to rotate about the initial axis of rotation. This accelerating torque is transmitted to the inertial mass through the spindle 128 and through the releasable coupler 132 to the drive shaft 130 of the inertial mass.

When the speed of rotation of the inertial mass about the initial axis of rotation reaches a speed at which it exceeds the rotational speed of the drive motor 122, the releasable coupling 132 causes the spindle 128 to become disengaged from the drive shaft 130. It also moves the spindle 128 axially back into the drive motor 122. The inertial mass is now free to rotate in its gimbal structure, and it continues its free running for a period of, for example, 12 minutes. When the inertial mass finally runs down, it rocks in its gyro structure to a position, such as the position shown in FIGURE 6.

The gyroscope of FIGURES 5 and 6 is mounted in the compartment 18 of FIGURE 1 in such a manner that the axis of rotation of the outer gimbal is directed along the longitudinal axis of the missile. The gyroscope assembly is so mounted in the compartment 18 with its base portion 112 attached to the walls of the compartment. The inertial mass 124 is set in motion in the manner described above and decoupled from the spring motor 122 at the beginning of the flight of the guided missile. Then, any tendency for the compartment 18 to rotate, causes the inertial mass to shift in its gimbal structure. This shift moves the armature of a potentiometer (not shown) which is mounted in the gimbal structure 126 in accordance with known practice. The resulting current from the potentiometer is introduced to the coil 56 of the electromagnetic clutch, to control the drag produced by the clutch so as to compensate for such tendency.

The angular orientations of the yaw and pitch canards 74 and 76 are controlled by radio signaled commands from the launching vehicle, as mentioned above, to enable the operator at the launching vehicle to maneuver the missile. The control of the canards is through a slant-wheel assembly, which is indicated in FIGURE 1 generally as 200. The assembly 200 includes a central bell-shaped drum 202 which is rigidly attached to the drive shaft 46, and it also includes two sets of rollers which ride on the inner and outer surfaces of the drum 202. These roller sets are designated 204 and 206 (see also FIGURE 3). Each set of rollers includes a first roller

which bears against the inner surface of the drum and a second roller which bears against the outer surface of the drum. These rollers are pre-loaded against the drum by resilient springs. This assures that no slippage occurs and efficient torque transmission can be accomplished.

The operation of the slant-wheel assembly is somewhat like a belt and pulley arrangement, for when a belt is not aligned with its pulley, a force is experienced by the belt directed along the axis of the pulley to pull it back into alignment with the pulley. However, when the belt is properly aligned with the pulley, no such force is experienced by the belt and it remains in place on the pulley. In a like manner, tilting or "slanting" the axis of the rollers 204 or 206 with respect to the axis of the drive shaft causes a force to be experienced by the rollers and, being free, they ride up and down the drum surface.

The rollers 204 are pivotally mounted on a U-shaped bracket 210. A connecting arm 212 (FIGURE 3) mechanically couples the bracket 210 to a collar 214. The collar 214 is rotatably mounted on a post 216 which, in turn, is fastened to the side wall of the forward compartment 50 by means of a screw 218. A connecting rod 220 is also secured to the collar 214.

The arrangement is such that when the rollers 204 are pivoted in one direction in the bracket 210, they ride along the surface of the rotating drum 202 in a direction to cause the bracket 210 to move and rotate the collar 214 so as to shift the connecting rod 220 rectilinearly and towards the forward end of the missile. Conversely, when the rollers 204 are pivoted in the opposite direction in the bracket 210, the connecting rod is caused to move rectilinearly and towards the after end of the missile.

The pitch canard 74 is mounted on a torque shaft 224 (FIGURES 1 and 4) which, in turn, is rotatably mounted in the forward section 50 of the missile and extends across that section. A sleeve 226 is clamped to the torque shaft 224 by screws, such as the screws 228. A radial arm 230 is formed integral with the sleeve 226, and this arm is coupled to the end of the connecting rod 220.

The pivotal movement of the rollers 204 is controlled by a pair of electro-magnets 234 and 236. These electro-magnets are mounted in a bracket 238 which is secured to the wall of the forward section 50 by means, for example, of screws 240, the sections of the clamp being clamped on the electro-magnets by a screw 242. A U-shaped bracket 244 inter-couples the rollers 204, and a pair of magnetic armatures (not shown) are secured to the bracket and extend in respective magnetic coupled relationship with the electro-magnets 234 and 236.

Then when one of the electro-magnets is energized, it draws its magnetic armature towards it with a resulting pivotal movement of the rollers 204 in the first direction to move the connecting rod 220 forward and shift the angular position of the pitch canard in one direction. In like manner, when the other electro-magnet is energized, the resulting pivotal movement of the rollers 204 moves the connecting rod 220 in the other direction to shift the angular position of the pitch canard in the opposite direction.

Similar electro-magnets are provided (not shown) which selectively attract magnetic armatures 240 and 242 to produce a pivotal movement of the rollers 206. This in a manner similar to that described above produces rectilinear movement of a connecting rod 242. The rod 242 is connected to the torque shaft 244 of the yaw canard 4. Therefore, controlled energization of the latter electro-magnets controls the angular position of the yaw canard.

The slant-wheel assembly, therefore, by means of the above-described linkage to the pitch and yaw canards 4 and 76, is capable of transmitting sufficient torque to operate the canard control surfaces during all phases of the flight of the missile.

The electro-magnets, such as the electro-magnets 234

and 236, are controlled by the radio receiver 72. The command signals transmitted to the radio receiver cause it to switch power from the direct current generator in the compartment 18 to designated ones of the electro-magnets.

As described above, the various electro-magnets are positioned to impart a left or right tilt to the rollers 204 and 206. As mentioned above, when any one of the electro-magnets is energized, the corresponding rollers are tilted in a particular direction. The spinning drum 202 now causes these rollers to ride up the surface of the drum, and a torque is transmitted to the corresponding canard through the linkage described in the preceding paragraphs.

This torque persists so long as the tilt persists and the corresponding one of the canards is rotated to its stop (not shown). When the power is removed, an appropriate centering spring (not shown) returns the rollers to their rest position and the corresponding canard is returned to its null position.

The mechanism described above permits both pitch and yaw maneuvers to be effectuated in response to ground controlled command signals.

A schematic circuit diagram of the electric system of the missile of FIGURES 1-4 is shown in FIGURE 8. As illustrated in FIGURE 8, the electrical system includes a source of direct current 300. This source may be a direct current generator coupled to the drive shaft 46 (FIGURE 1) or it may be appropriate batteries. The source 300 is located in the compartment 18 of FIGURE 1.

The positive terminal of the source 300 is connected to one terminal of a potentiometer 302; to a plurality of normally open relay contacts 304, 306, 308 and 310; and to the radio receiver 72. The negative terminal of the source 300 is grounded.

The potentiometer 302 is mechanically coupled to the gyroscope assembly of FIGURES 5 and 6, and its armature is controlled by the gyroscope, as mentioned above. The armature of the potentiometer 302 is connected to one terminal of the coil 56 of the electro-magnetic slip clutch, the other terminal of which is grounded. Thus, the amount of current flowing through the coil 56 is controlled by the potentiometer 302 which, in turn, is controlled by the gyroscope. This enables the gyroscope to control the amount of drag exerted by the clutch, for the reasons described above.

The source 300 also supplies power to the radio 72. The radio receives command signals over a receiving antenna 314, and it detects the command signals in known manner to selectively energize the relay coils 316, 318, 320 and 322. This selective energization of the relay coils causes the contacts 304, 306, 308 and 310 selectively to close.

The armatures of the contacts 304 and 306 are respectively connected to the yaw canard control electro-magnets which are designated 235 and 237 in FIGURE 8. Likewise, the armatures of the contacts 308 and 310 are respectively connected to the pitch canard control electro-magnets 234 and 236. The other terminal of each of the electro-magnets is grounded.

Therefore, the receipt of an appropriate command signal by the radio receiver 72 causes the corresponding one of the relays 316, 318, 320 and 322 to be energized to close the corresponding one of the contacts 304, 306, 308 and 310. This energizes the corresponding one of the electro-magnets 234, 235, 236, 237 to turn the canard designated by the command signal in the direction designated by that signal.

The invention provides, therefore, a simple, rugged and relatively inexpensive guided missile. As described above, the guided missile of the invention includes an improved and simplified mechanism for maintaining a section of the missile at a set angular orientation such

as a non-rotating condition about the longitudinal axis of the missile to properly position the yaw and pitch canards. Moreover, the missile of the invention includes a simplified radio-controlled system which responds to remote command signals to control the yaw and pitch canards and so permit the missile to be maneuvered.

I claim:

1. A vehicle adapted to be propelled through space including: a first section, a second section, means for supporting the first and second sections in axial alignment with one another for relative rotation about the longitudinal axis of the vehicle, means coupled to the first section for imparting rotational motion to the first section in a particular direction about said longitudinal axis, means coupled to the second section for tending to impart rotational motion to the second section in a direction opposite to said particular direction about said longitudinal axis, variable torque means coupled between said first section and said second section for applying a variable controlled torque between said sections, and means responsive to the angular rotation of said second section and operatively interconnected with said torque means for introducing a control signal to said variable torque means to control the amount of torque translated between said sections to maintain said second section at a particular orientation with respect to said longitudinal axis.

2. A vehicle adapted to be propelled through space including: a first section, a second section, means for supporting the first and second sections in axial alignment with one another for relative rotation about the longitudinal axis of the vehicle, means coupled to the first section for imparting rotational motion to the first section in a particular direction about said longitudinal axis, canard control means coupled to the second section for applying a torque to the second section in a direction opposite to said particular direction about said longitudinal axis, gyroscopic means coupled to the second section, means coupled to the gyroscopic means for developing a control signal indicative of shifts in the angular position of the second section about said longitudinal axis from a particular angular orientation, means coupled to the first section and including a signal-controlled clutch mechanism for translating a torque from said first section to the second section in opposition to said applied torque, and means coupled to the developing means

for introducing the control signal from the developing means to the clutch mechanism to control the amount of torque translated to the second section by said translating means so as to maintain said second section at said particular orientation.

3. A vehicle adapted to be propelled through space including: an after section, bearing means coupled to the after section for rotatably supporting the same for rotation about the longitudinal axis of the vehicle, at least one fin member positioned on the after section for causing the after section to spin about said longitudinal axis, a forward section, means for coupling the forward section to the bearing means, gyroscopic means coupled to the forward section for maintaining the same at a particular angular position with respect to the longitudinal axis, a drive shaft, means for rotatably supporting the drive shaft in the forward section, means for coupling the drive shaft to the after section for imparting rotational motion to the same in accordance with the rotation of said after section, canard means positioned on the forward section for maneuvering the vehicle, means intercoupling the drive shaft to the canard means for translating controlled movements to the canard means from the drive shaft, said intercoupling means including a drum mounted on said drive shaft and rotatable with said drive shaft, pivotally mounted rollers positioned against said drum and mounted on said forward section, means connecting said rollers to said canard means for translating controlled movements of said rollers to movements of the canard means, and electromagnetic means for selectively pivoting said rollers to selectively change the position of said rollers against said drum.

4. The combination of claim 3 including a remotely controlled guidance means disposed in said forward section and operatively interconnected with said canard means for controlling the flight of said vehicle.

5. The combination of claim 3 wherein said after section includes a rocket propellant for powering said vehicle in space.

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