Dec. 25, 1951 J. H. HOMRIGHOUS 2,579,823

SYSTEM FOR CONTROLLING THE PATH OF BOMBS AND PROJECTILES

Original Filed Jan. 8, 1942 2 SHEETS—SHEET 1

Fig. 1.

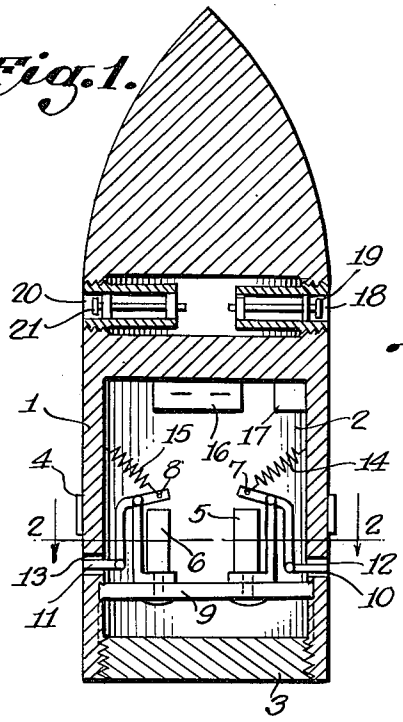
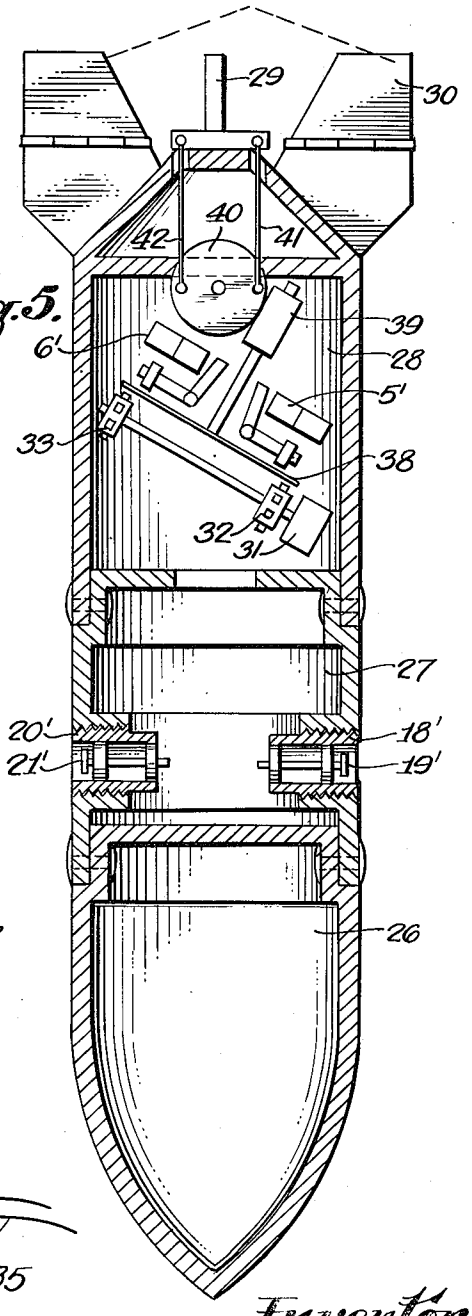


Fig. 5.



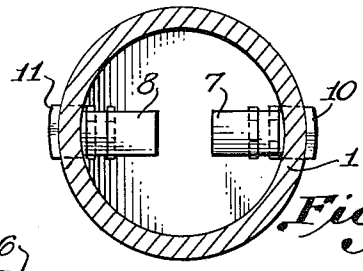


Fig. 2.



Fig. 4.

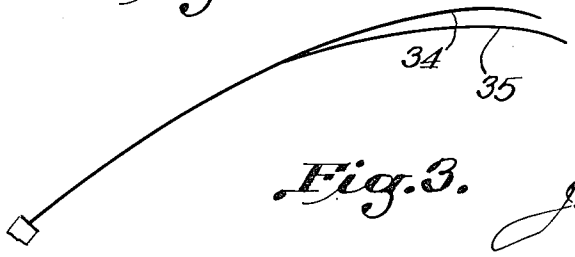


Fig. 3.

Inventor,

John H. Homrighous

Dec. 25, 1951 J. H. HOMRIGHOUS 2,579,823

SYSTEM FOR CONTROLLING THE PATH OF BOMBS AND PROJECTILES

Original Filed Jan. 8, 1942 2 SHEETS—SHEET 2

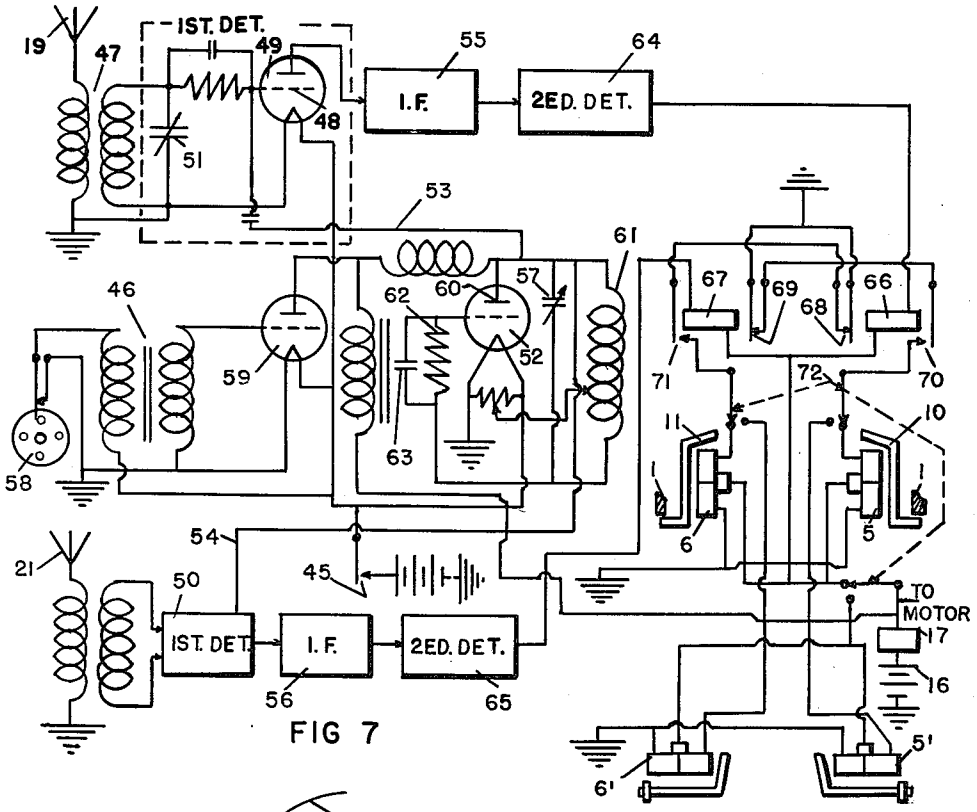


FIG 7

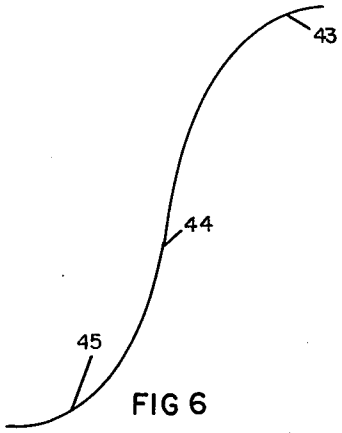


FIG 6

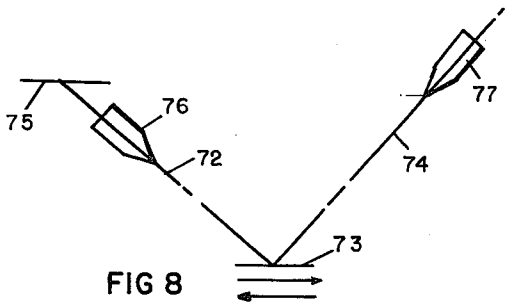


FIG 8

INVENTOR.

John H. Homrighous

Patented Dec. 25, 1951

2,579,823

UNITED STATES PATENT OFFICE

2,579,823

SYSTEM FOR CONTROLLING THE PATH OF BOMBS AND PROJECTILES

John H. Homrighous, Oak Park, Ill.

Original application January 8, 1942, Serial No. 425,972, now Patent No. 2,432,421, dated December 9, 1947. Divided and this application November 13, 1947, Serial No. 785,667

8 Claims. (Cl. 343—225)

1

My invention relates in general to improved means for automatically controlling the path of bombs and projectiles after they have been released from airplanes or fired from guns in order to score a greater number of hits.

This application is a division of my application Serial No. 425,972, filed January 8, 1942, now Patent 2,432,421.

Accordingly, one of the main objects of my invention is to provide a moving object or vehicle with means to automatically direct or steer the object on a course to a stationary or moving source of radiated power, or from a source of power radiated in a certain direction or to automatically follow radio waves reflected from a stationary or moving target.

Another object of this invention is to provide two or more radio receiving stations in a movable object or vehicle under control of predetermined carrier waves common to each receiving station for independently controlling the steering mechanism or rudder to automatically maintain the vehicle or moving object traveling the carrier waves.

Another object is the provision of means whereby radio devices in a moving object or bomb are rendered operative a short interval of time after the object has been released.

Another object is the provision of means in a bomb for changing its direction of travel from approximately a vertical descent to approximately a horizontal motion whereby the bomb may be directed toward the side of a ship near the water line rather than on top of the ship.

Still another object of my invention is to maintain the present design of guns and of aircraft while the changes to accomplish the above objects are practically all made in the projectile or bomb.

One of the main advantages of this invention over the prior art is in developing control signals in the moving vehicle or object rather than modulating the control signals on the carrier wave so that the station apparatus in the object may be positively controlled by signals having uniform potential which are not affected by carrier wave reflections or noise.

Other objects, features, and advantages will appear in connection with the accompanying drawings illustrating an embodiment thereof in which:

Figure 1 shows a cross section of a projectile having a compartment for mechanisms to control its direction of travel.

Figure 2 is a partial detail view, showing the control of steering members, taken on line 2—2 of Figure 1.

2

Figures 3 and 4 show curves illustrating the trajectory of a projectile.

Figure 5 shows a cross section of a bomb having mechanism for changing its trajectory.

Figure 6 shows a curve illustrating the trajectory of a bomb.

Figure 7 shows a circuit for controlling the steering mechanism in bombs and projectiles.

Figure 8 illustrates carrier wave paths for radio guided vehicles or bombs.

Figure 1 shows a projectile having a compartment for holding apparatus which may be operated through suitable circuit arrangements controlled by received carrier waves to increase the air friction of the projectile or to increase its resistance through air, thereby controlling its trajectory. The numeral 1 indicates a projectile or shell having a chamber or compartment 2 for control mechanism which may include suitable circuit arrangements controlled by received radio carrier waves, to thereby control the direction of flight of the projectile or shell after a predetermined time interval has elapsed from the instant it is fired from a gun. The bottom closure 3 for the chamber is arranged to be screwed into the opening in the base of the projectile. The band 4 is of soft metal to engage the rifle grooves in the gun barrel.

Inside the chamber 2 there may be located in suitable manner the radio stations and associated apparatus shown in Figure 7. Two electromagnets 5 and 6 having armatures 7 and 8 are mounted on plate 9. The armatures 7 and 8 at their lower extremities are provided with flanges 10 and 11 adapted to protrude through small apertures 12 and 13 in the casing wall, as shown in Figure 2, to increase air friction, thereby retarding the projectile. The armatures may be held in the position shown in Figure 1 by the springs 14 and 15. Station battery or a source of electrical energy 16 and a timer 17 similar to those in use may be located in chamber 2 as illustrated in Figure 1. The timer 17 may be actuated a predetermined period of time after the projectile leaves the gun to close a circuit from battery 16 to the electromagnets and receiver circuits.

With further reference to Figure 1, I have shown above the apparatus chamber 2 a small bore extending through the center of the projectile, having an antenna tube 18 secured in one end of the bore. An antenna 19 may be disposed in the center of and insulated from the

tube 18. Another antenna tube 20 may be secured in the opposite end of the bore. A second antenna 21 may be disposed in the center of and insulated from the tube 20. Connections from these antennas (not shown) may extend through the chamber ceiling to the radio stations located in the chamber. The antennas 19 and 21 may be small loop aerials, as is illustrated, and are directional, that is, carrier waves may only be received over the antenna nearest to the source of electro magnetic waves on the target within the view of the antenna as the projectile rotates through space. These antennas are primarily intended to work over very short ranges.

Referring to Figure 3, the curve 34 may illustrate the trajectory for a projectile, similar to Figure 1, fired from a long range gun. Should the projectile be retarded by the protruding flanges, the trajectory may be as shown by the curve 35.

Referring to Figure 4, the curve 36 may illustrate the trajectory for an anti-aircraft projectile, which may be directed considerably ahead of the approaching airplane. Should the projectile, similar to Figure 1, be retarded by the flanges extending beyond the outside of the casing, it may then follow the curve 37.

With reference to Figure 5, I have shown a bomb adapted to be released from an airplane, having apparatus and suitable circuits for changing its direction of travel from approximately a vertical position to a gliding or approximately a horizontal motion, whereby the bomb may be directed toward the side of a ship, near the water line rather than on top of the vessel.

The bomb may comprise three compartments 26, 27 and 28. Compartment 26 may comprise the explosive portion of the bomb, with the intermediate compartment 27 having radio antennas with the apparatus and associated receiving circuits of Figure 7 for controlling the steering mechanism mounted in compartment 28.

The hood or top compartment 28 may have the rudders 29 and 30 rotatably mounted thereon under control of radio carrier waves to steer the bomb or moving object over the carrier wave path, to be more fully explained later. This compartment 28 may have securely mounted therein a motor 31 which operates continuously after the timing mechanism shown in Figure 7 is actuated to close a circuit from the battery 16 to the motor. The motor 31 drives two gears 32 and 33, adapted to engage the flexible disk 38 secured to the worm gear 39 to in turn drive, in either direction, its associated gear 40 for adjusting the fins or rudder 29 through the cables 41 and 42. The rudder 30 may be operated by similar mechanism not shown to steer the moving object at right angles to the path controlled by the rudder 29.

In the intermediate chamber 27, which may be a part of the compartment 28, I have shown the antenna 19' disposed in the center of and insulated from the tube 18' which is secured in the compartment wall, and on the opposite side of the compartment another antenna tube 20' may be secured, having an antenna 21' disposed in the center of and insulated from the tube 20'. These antennas may be directional, as explained in connection with Figure 1.

Inside the compartment 27 and 28, there also may be located the receiver circuits and associated apparatus shown in Figure 7. The electromagnets 5' and 6' mounted in the upper compartment are adaptable to flex the disk 38 to engage either the sprocket 32 or 33 to rotate the rudder 29 in either direction depending upon which side of the bomb is nearest the broadcasting source. Assuming that the bomb is not revolving on its descent, but the object or target is moving, then the radio carrier waves transmitted to or from the target may be alternately received over the antennas 19 and 21 to cause the rudder to be alternately operated from one side to the other in order to steer the bomb along the radio carrier wave path. While I have shown two radio receiving stations for controlling the path of the bomb, it is to be understood that the fin or rudder 30 may be controlled by another pair or receivers similar to those shown in Figure 7 so that the moving object may be controlled in various directions without a whirling motion.

The path of a bomb may be as illustrated in Figure 6 where 43 may represent the position of the bomb shortly after it has been released by an airplane, which may follow a downward course as shown at 44 until controlled by received radio carrier waves to cause the bomb to take a gliding motion at 45.

The radio stations and associated apparatus of Figure 7 may be mounted in chamber 2 of the projectile shown in Figure 1, or in the compartments 27 and 28 of the bomb Figure 5. The radio tubes are small with the filaments operating from battery. The receiving circuits, of which there are two, are of the superheterodyne type. These circuits may be inoperative until a predetermined period of time after the projectile has been fired from the gun or until the timer 17 operates to close the battery circuit to the anodes of the various tubes, motor 31, and to the several relays and control magnets. The timer 17 may be omitted in which case the tube anodes and relays may be connected to battery. The contacts 45 may be closed by the removal of a safety pin (not shown) from the projectile or bomb before placing the projectile in the gun or before launching the bomb. The making of contacts 45 closes the battery supply circuit to the several tube filaments and also to the modulation transformer 46.

The apparatus and associated circuits shown in Figure 7 may through carrier waves received over antennas 19 and 21 retard the speed or control the direction of travel of a moving object in which the apparatus and associated circuits are carried. Radio carrier waves intercepted by the antenna 19 may be supplied through the antenna transformer 47 to the grid 48 of the mixer or first detector tube 49. Radio carrier waves intercepted by the antenna 21 may be supplied through a similar antenna transformer to the grid of the first detector stage 50. The variable condenser 51, bridged across the secondary of the antenna transformer 47 tunes the grid input circuit to any desired wave length. An oscillator stage 52 common to both receivers produces radio frequency waves which are applied over conductors 53 and 54 to the mixer stages 49 and 50 to react, on the heterodyne principle, with the received carrier waves to produce intermediate frequency waves in both stages 55 and 56. The condenser 51 and a similar condenser (not shown) in the first detector stage 50 and also the condenser 57 in the oscillator circuit may all be adjusted by a single control so that both receivers are tuned to the same carrier waves and the oscillator tuned to produce the proper frequency for substantially constant intermediate frequency.

The frequency waves produced in the oscillator stage 52 may be modulated by impulses produced

by the generator or interrupter 58 supplied through transformer 46 to the modulation amplifier 59. This interrupter 58 may be rotated by a small motor (not shown), or by the clock mechanism in the timer to produce control signals or impulses having a frequency which may be different than the range of voice and telegraph signals. The modulation amplifier 59 varies the amplitude of the oscillations produced at the anode 60, through the tuned coil 61, grid resistance 62, and condenser 63. Therefore, it is seen that the radio frequency waves produced by the local oscillator 52 are modulated by impulses or control signals also produced in the receiver circuits, whereby the intermediate frequency waves in either or both intermediate amplifier 55 and 56 are modulated by these same signals upon reception of a carrier wave of a certain frequency. The control signals or impulses may be demodulated and amplified in stages 64 and 65 to energize the relays 66 and 67. The relays 66 and 67 may be adjusted to respond only to the high voltage impulses produced in the local generator 58. Therefore, signals representative of coded messages or telephonic messages modulated on received carrier waves will not cause operation of the relays 66 and 67.

Assuming that the antennas 19 and 21 are mounted 180 degrees apart in the projectile of Figure 1, or the bomb of Figure 5, and that the carrier waves are intercepted by both antennas, then control impulse would be produced in both stages 64 and 65 to cause energization of both relays 66 and 67, with both relays energized at the same time, which is the condition that would exist when the projectile is traveling on a carrier wave; no steering mechanism would be actuated because relay 66 opens the circuit of electromagnet 6 at spring contacts 68 and relay 67 opens the circuit of electromagnet 5 at spring contacts 69. However, should the projectile be traveling to one side of the path of carrier waves received from a target or other transmitter, then signal impulses from the generator 58 will be produced alternately in the detector stages 64 and 65 as the projectile rotates through space. In other words, only the antenna nearest the source of carrier wave energy or in the view of the target will intercept the carrier waves at any instant. The relays 66 and 67 energized alternately from the impulses produced in stages 64 and 65 may intermittently close energizing circuits through make spring contacts 70 and 71 to the control electromagnets 5 and 6. These magnets, upon energizing, operate the flange levers 10 and 11 to control the path of the projectile. The electromagnets 5 and 6 may have auxiliary windings for maintaining them partially energized. Therefore, the flanges will be alternately extended beyond the outside casing wall of the projectile as it rotates to increase the air drag or resistance on the side within the view of the source of radio carrier wave energy at the target.

To utilize the circuits and associated apparatus of Figure 7 in the bomb Figure 5, the electromagnets 5 and 6 are replaced through the operation of switch 72, by the electromagnets 5' and 6' for flexing the disk 40.

Referring to Figure 8, I have illustrated a path of radio carrier waves by the line 72 to or from a movable target 73. Also a reflected wave path 74 from the target 73. Radio waves may be beamed from an airplane 75 to the target 73 by which a bomb 76 may be controlled to follow the beam or path 72, or bombs such as 77 may be controlled

by the radio waves reflected from the target to follow the radio path 74 to the target. It is to be understood that the radio carrier waves may be produced and transmitted at the target 73 which may steer the moving objects 76 and 77 to the target.

From the above description it will be seen that I have provided means for automatically guiding a projectile or moving object through space by utilizing radio carrier waves.

It is to be understood that the radio carrier for controlling a projectile or bomb may be reflected from the target instead of being developed at the target or object, in which case a beamed transmitting station would direct its radiation toward the target from some remote distance and the receiver in the projectile would be tuned to the reflected carrier.

With the foregoing and other objects in view, the embodiments of the invention which have been given herein are illustrative of how the various features may be accomplished and of the principles involved. It is to be understood that the invention contained herein is capable of embodiment in many other forms and adaptations without departing from the spirit of the invention and the scope of the appended claims.

Having thus described my invention I claim:

1. In a system for controlling the path of a moving object, a steering device for directing the movement of said object, an electromagnet for controlling said device, a heterodyne radio receiver disposed in said object, an oscillator connected with said receiver to produce radio frequency waves, generator means associated with said oscillator including a movable member to produce control signals, means including a first amplifier to amplitude modulate said radio frequency waves with said control signals, means in said receiver to receive carrier waves, means in said receiver including a second amplifier to combine said modulated radio frequency waves and said carrier waves to produce intermediate frequency waves amplitude modulated with said signals, means to amplify said modulated intermediate frequency waves, means to demodulate said amplified intermediate frequency waves to produce said signals, and a relay in said receiver responsive to said demodulated signals to cause energization of said electromagnet, thereby adjusting the said steering device to alter the path of said object.

2. In a system for controlling the path of a moving object, an adjustable steering device mounted on said object for directing its movement, a heterodyne radio receiver disposed in the said object, an oscillator cooperating with said receiver to produce radio frequency waves, generator means associated with said oscillator including a movable member to produce control signals, means including a first amplifier to amplitude modulate said radio frequency waves with said control signals, means in said receiver to receive carrier waves, means in said receiver including a second amplifier to mix said modulated radio frequency waves and said carrier waves to produce intermediate frequency waves amplitude modulated with said signals, means to amplify said modulated intermediate frequency waves, means to demodulate said amplified intermediate frequency waves to produce said control signals amplified, and means in said receiver including an electromagnetic member to utilize said amplified control signals to control said steering device to change the trajectory of said object.

3. In a system for controlling the path of a gravity bomb, a steering device rotatably mounted on said bomb for directing its movement, a pair of heterodyne radio receivers in said bomb having antennas located on opposite sides of said bomb, an oscillator common to said receivers to produce radio frequency waves, means associated with said oscillator to produce control signals, means including a first amplifier to modulate said radio frequency waves with said control signals, means to receive carrier waves through one of said antennas having the shortest distance to a source of radiated energy, means including a second amplifier in one of said receivers associated with said one antenna to mix the said modulated radio frequency waves and said carrier waves to produce intermediate frequency waves modulated with said control signals, means to amplify said modulated intermediate frequency waves, means to demodulate said amplified intermediate frequency waves to produce said control signals amplified, and means in said one receiver including an operable member to utilize said amplified control signals to control said steering device to change the trajectory of said bomb.

4. In a system for controlling the path of a moving object, a steering device for directing the movement of said object, first and second heterodyne radio receivers in said object having first and second antennas respectively located on opposite sides of said object, an oscillator, cooperating with said receivers, to produce radio frequency waves, means associated with said oscillator to produce control signals, means including a first amplifier to modulate said radio frequency waves with said signals, means including said first antenna to receive carrier waves, means in said first receiver including a second amplifier to mix the said modulated radio frequency waves and said carrier waves to produce intermediate frequency waves modulated with said signals, means to amplify and demodulate said modulated intermediate frequency waves to produce a first series of said control signals, means including a first electromagnetic device in said first receiver to utilize the said first series of control signals to cause rotation of said steering device to change the trajectory of said object, means including said second antenna to receive said carrier waves, means in the said second receiver including a third amplifier to mix the said modulated radio frequency waves and said carrier waves to produce other intermediate frequency waves modulated with said control signals, means to amplify and demodulate said other modulated intermediate frequency waves to produce a second series of said control signals and means including a second electromagnetic device in said second receiver to utilize the said second series of control signals to cause reverse rotation of said steering device.

5. In a system for controlling the path of a moving object, a pair of radio receiving stations disposed in said object, each provided with a directional antenna, said antennas located on opposite sides of said object, pulse generator means in said object to produce control signals, means in a first one of said receivers under control of carrier waves received over its associated antenna for utilizing said control signals to steer said object toward the path of the carrier waves, and means thereafter in the second one of said receivers under control of said carrier waves received over the other said antenna for utilizing said control signals to steer said object in the same direction relative the path of said carrier waves.

6. In a system for controlling the path of a moving object, a pair of radio heterodyne receivers disposed in said object each provided with a directional antenna, said antennas located on opposite sides of said object, a rudder rotatably mounted on said object, a generator to produce control signals, means in a first one of said receivers under control of carrier waves received over its associated antenna for utilizing said control signals to cause rotation of said rudder thereby steering said object toward the left, means in a second one of said receivers under control of carrier waves received over its associated antenna for utilizing said control antenna to cause reverse rotation of said rudder thereby steering said object to the right.

7. The system for controlling the path of a moving object as claimed in claim 6 including in addition motors for rotating said rudder connected to a power supply circuit, and means to open the power supply circuit to said motors upon reception of carrier waves over both of said antennas at the same time.

8. The system for controlling the path of a moving object as claimed in claim 6 including in addition another pair of radio receivers with another pair of antennas, and a second rudder, with means under control of received carrier waves to cause rotation of said second rudder to steer said object upward and downward.

JOHN H. HOMRIGHOUS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,907,965	Hansell	May 9, 1933
2,245,685	Koch	June 17, 1941
2,247,294	Gable et al.	June 24, 1941
2,399,954	Thomson	May 7, 1946
2,404,344	Wild	July 16, 1946
2,408,819	Sorensen	Oct. 8, 1946
2,414,103	Hunter	Jan. 14, 1947