May 4, 1965 R. N. GIBSON 3,181,272

REMOTE CONTROLLED TOY SUBMARINE

Filed Sept. 25, 1962 2 Sheets-Sheet 1

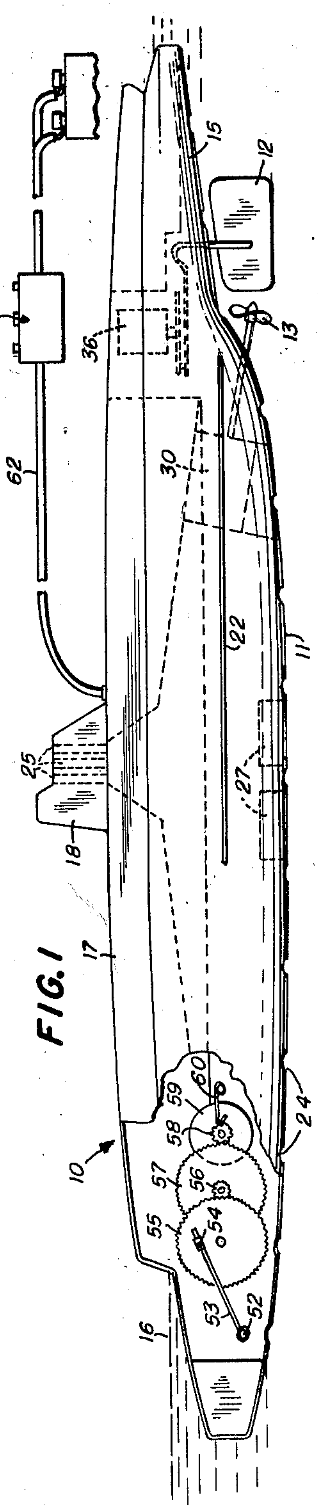

FIG. 1

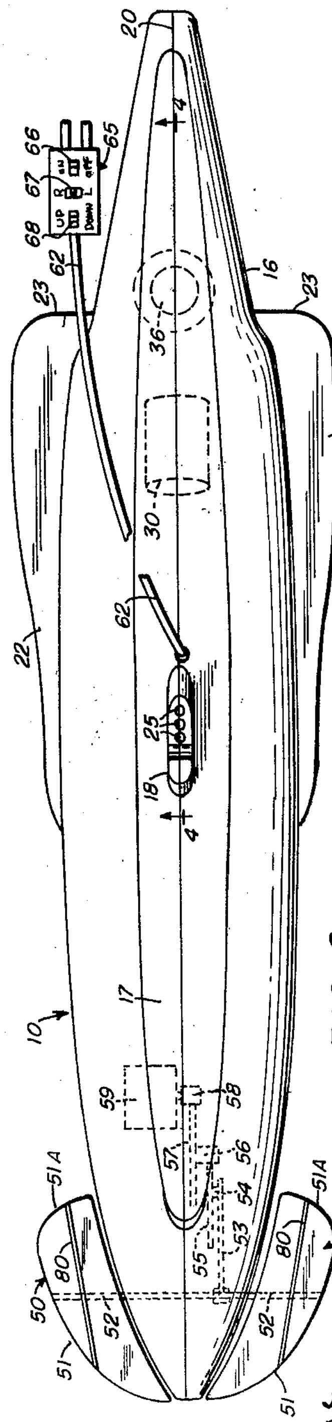

FIG. 2

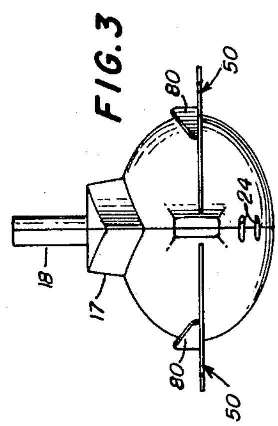

FIG. 3

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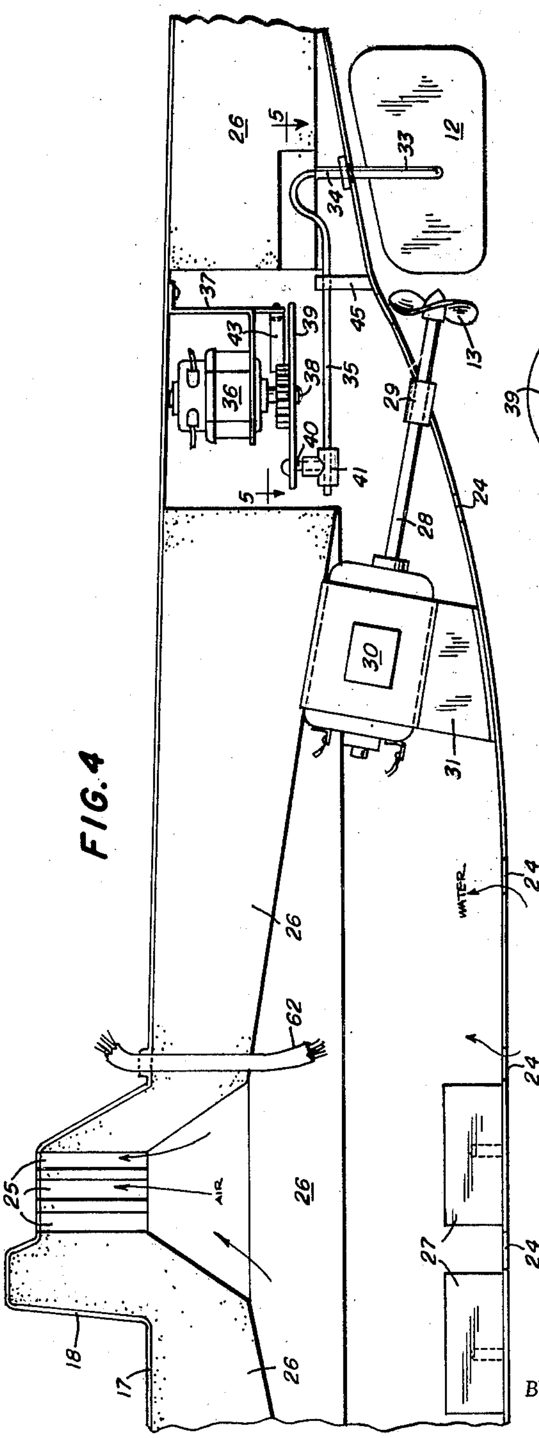

FIG. 4

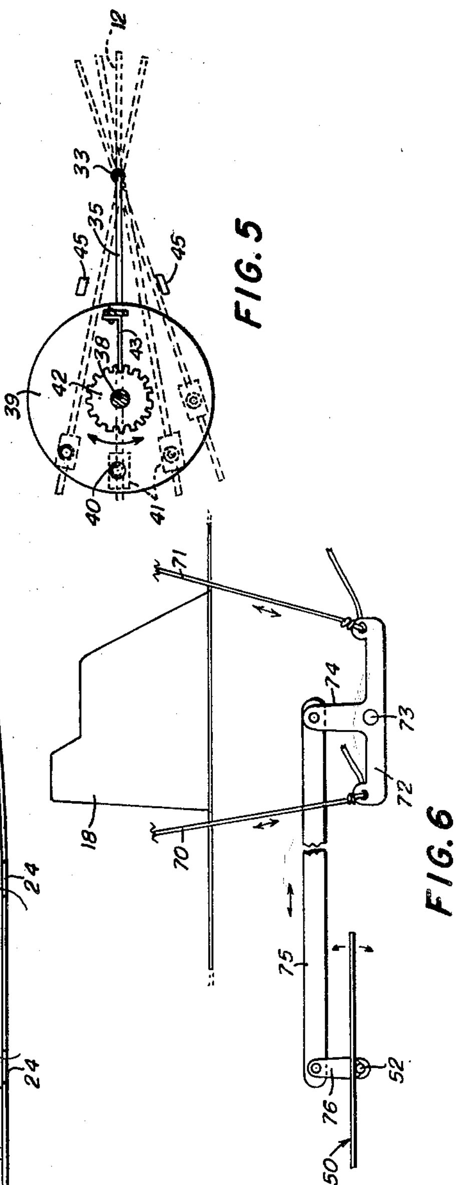

FIG. 5

FIG. 6

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REMOTE CONTROLLED TOY SUBMARINE

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6 Claims. (Cl. 46—244)

This invention relates to toy submarines and more particularly to such devices arranged for remote control, when submerged and for diving and resurfacing.

It is the general object of the present invention to provide a toy submarine of realistic appearance and action together with remote control means for such action enabling the operator to simulate the maneuvers of a modern naval submarine.

More particularly it is an object of the present invention to provide in a toy submarine a propeller and at least one rudder device each actuated by an electric motor from a remote source of power through conductors and controls handled by the operator.

An important object of the invention resides in arrangements of the flotation and ballasting means for the submarine whereby it may surface or dive solely under the action of diving rudders and the driving propeller.

Another important object of the invention comprises improving the diving characteristics by opening substantially the whole hull to the entrance and exit of water whereby flotation is largely independent of the depth of partial submergence to contribute greater diving and surfacing facility under the sole action of diving rudders and propulsive means.

A further important object of the invention includes the provision of unique motor drive mechanism for rudder actuation which greatly simplifies the control mechanisms handled by the operator.

Other and further objects and specific features of the invention will be more apparent to those skilled in the art upon a consideration of the following specification and the accompanying drawings wherein are disclosed several exemplary embodiments of the invention, with the understanding that such changes and modifications may be made therein as fall within the scope of the appended claims without departing from the spirit of the invention.

In said drawings:

FIGURE 1 is a side elevation of a toy submarine constructed in accordance with the present invention illustrating certain of the driving and control mechanism and other components in dotted lines, and the power source and control panel;

FIGURE 2 is a top plan view of the submarine illustrating the diving rudders, vertical and horizontal fins and a plan view of the control panel;

FIGURE 3 is a bow view of the submarine;

FIGURE 4 is a side elevational of the after portion of the submarine with one-half of the hull shell removed to illustrate the interior arrangement;

FIGURE 5 is a fragmentary horizontal section taken on line 5—5 of FIGURE 4 illustrating the driving mechanism of the rudder for horizontal control; and

FIGURE 6 is a schematic illustration of alternative mechanism for manual control of the diving rudders or fins.

The submarine of the present invention is an operating toy, designed and constructed to appear and operate as nearly realistically as a full size submarine as is possible, in a miniaturization which can be manufactured and sold at a reasonable cost. In order that it may be capable of maneuverability as regards direction and speed on the surface, and diving and surfacing with lateral control available also while under water, a source of electric power such as a storage or primary battery or the like is provided for use on the shore or in a larger boat in which

the operator may be seated and a cable of any desired length and of suitable flexibility and waterproof characteristics connects motors in the toy submarine to the source of power through suitable controls within reach of the operator. A propulsive motor, which can be arranged, if desired, for operation at various speeds and even reversed if necessary, drives the vessel through the usual screw type propeller and one or more additional motors are made use of for controlling lateral steering and diving and surfacing operations, these being supplied with power from the same source through separate controls.

Referring now to the drawings for a better understanding of the invention it will be noted from FIGURES 1 and 2 that the hull 10 of the toy submarine provides a reasonably close approximation of the appearance of the more modern naval submarines, being generally torpedo shaped and, as seen in FIGURE 3, is generally elliptical in cross-section, although this form is not essential and tapers from the center toward the ends. The convex underbody 11, at about the center of the craft, has the greatest depth, so that should it drag along the bottom, the rudder 12 and propeller 13 will be protected against damage. These two parts are fitted beneath a kick section 15 at the rear of the hull as shown and preferably the hull is also narrowed in this area as is more apparent at 16 in FIGURE 2. The hull is so designed, ballasted and provided with flotation means that under normal circumstances it assumes the water line as illustrated at 16 in FIGURE 1, i.e. the portion with the elliptical cross-section is substantially immersed, but there is provided an elevated or raised deck 17 running longitudinally for almost the full length of the craft and having a tapered shape as seen in FIGURE 2. This portion remains out of the water when the craft is running "surfacing." For the sake of appearance the conning tower or "sail" 18 extends upwardly from the center of this raised deck section and may be configured as designed for realism.

The hull can be made from thin sheet metal, preferably of the non-rusting type and comprises two stampings which are mirror images of each other joined along the vertical median plane 20 of the craft in any suitable and simple manner, water tightness not being required as will later appear. For simplicity the interior parts may all be fastened to one of the sides to simplify the construction and facilitate assembly.

To minimize rolling and to steady the craft in rough water, laterally extending fins 22 are provided as best seen in FIGURE 2 extending from somewhat forward of the midship position to aft of the beginning of the taper providing the narrow section 16 and these fins gradually widen from the forward end toward the after, where they are cut off sharply as seen at 23. Their position vertically is somewhat below the vertical center of the elliptical cross-section so that they will be well submerged even though the craft is running surfacing. While shown as in the same horizontal plane these could be either canted downwardly or upwardly with no substantial reduction in their effectiveness and without adding additional resistance to propulsion.

In order that submersion may be effected with a minimum of effort without requiring changing of the ballasting of the craft, as by the use of tanks for water ballast as in naval submarines, the hull is open for free access to water and air by the plurality of openings 24 seen in FIGURE 1 through the bottom of the hull, and the vertical stacks 25 through the conning tower. With this arrangement there is no natural buoyancy to the hull and some must be provided to prevent it from sinking and this is achieved by lining the upper portion of the hull with suitable plastic foam as shown at 26 in

FIGURES 1 and 4. As better illustrated in FIGURE 4 this material fills the upper portion of the hull, where it is not occupied by propulsion equipment, and extends up into the raised deck and the conning tower. The quantity needed can readily be ascertained by experiment and adjustments may be made by changing the mass of the ballast weights **27**, shown secured to the bottom of the hull adjacent the center portion thereof or wherever it is found necessary to balance the propulsive equipment against the flotation characteristics of the cross-section where it is located. In any event, the ballast weights are as low as possible in the hull and the flotation material as high as possible, giving maximum stability and permitting the toy to be tossed into the water in any position and to immediately right itself. This is highly desirable in cases where it is difficult to reach the water because of high banks or the like.

Propulsion is by means of the propeller **13** whose shaft **28** passes through the hull at stern bearing **29** which does not need a stuffing-box because the hull is not watertight as previously stated. This shaft is either directly connected, or through appropriate gearing, to an electric motor **30** supported by brackets **31** from the bottom of the hull. The motor can either be of a waterproof type or arranged in a watertight compartment, as desired. However, because of the low voltage requirements it is perhaps simpler to have a watertight motor thereby eliminating the buoyant effect of the necessary compartment to house, which make diving more difficult or at least require additional ballast weights.

Steering for lateral control and guidance, both on the surface and when beneath the water, is effected by means of the more or less conventional rudder **12** which is substantially balanced by having its vertical shaft **33** arranged near the fore and aft center of the area thereof to simplify the steering operation and reduce the power necessary for the purpose. This shaft is reduced in diameter and passes through a stern bearing **34** secured to the lower part of the hull and is then bent at substantially a right angle and extended forwardly in the form of a steering arm **35**. A suitable, small, electric, steering motor **36** is supported by a suitable bracket, such as shown at **37**, from either the upper or lower portion of the hull and carries on its vertical central shaft **38** a disc **39**, through which a pivot **40** passes which is rotatively attached to the sleeve **41** sliding on steering arm **35** so that as the motor is rotated the rudder is deflected as indicated in dotted lines in FIGURE 5.

The disc **39** is shown as directly connected to the shaft of the motor but this connection is optional. Generally it is better to introduce a gear train since the speed of the motor is normally too great for rudder adjustment. Small motors are available with a gear train built into the housing and it is assumed in the illustration in FIGURE 4 that this arrangement is provided, but an external reducing gear train of conventional style can be used if desired. In any event, one of the gears, the edge of the disc **39**, or as shown, a separate toothed wheel **42** secured to the upper face of the disc, cooperates with the free end of leaf spring **43**, supported at its remote end by an extension on bracket **37** provides means for holding the rudder in any adjusted position. Thus, the spring which is relatively flexible extends between any pair of teeth of the gear, as shown in FIGURE 5 and is of insufficient strength to prevent the motor from operating when energized for a short duration. Thus, the motor rotates disc **39** to the extent of the required number of teeth on the gear and the spring then snaps between the next pair of teeth and locks the rudder in the adjusted position.

It is obvious from FIGURE 5 that if the motor can operate only in a single direction that after the disc moves approximately 90 degrees, from the position where the sleeve **40** and the tiller **35** are centered, as shown in full lines in FIGURE 5, the maximum position of the rudder is passed and further movement returns it toward the central position which it will achieve when the sleeve **41** reaches 180 degrees from the illustrated position. Thereafter continued rotation of the motor in the same direction begins to steer the boat in the opposite sense. However, many small motors are available using permanent field magnets and they, of course, can be reversed merely by reversing the direction of current delivered to the motor armature. This is a simplification of the arrangement wherein an electric magnet field is used since that requires three control wires for reversal.

In the case where a reversible motor is used, stops such as shown at **45** mounted on permanent portions of the hull may be provided to limit the stroke of the tiller **35** to prevent excess angle being given to the steering rudder. As an alternative the length of the diameter at which the pivot **40** for the sliding sleeve **41** is attached to the disc **39** may be the controlling factor for the maximum angle of displacement of the rudder.

The final system of controls for the craft comprises a set of diving planes or rudders sometimes referred to as "fins," illustrated at **50** in FIGURES 2 and 3. They each comprise a flat sheet of rigid metal curved on the inner edge to substantially conform to the shape of the prow of the submarine, with increased curvature outer edge **51** and short, curved rear edge **51A**, the two fins being secured to and supported by means of a transverse shaft **52** extending through the hull, mounted in appropriate bearings thereon and positioned to place the fins well below the surface of the water when the craft is operating on the surface. Like the shaft for the rudder **12**, the cross shaft **52**, which supports the fins **50**, has secured thereto a radial arm **53** of appropriate length, equivalent to a tiller, and this is fitted with a slider **54** pivoted to the underface of a large gear **55** operating on an axis transverse to the craft. The toothed periphery of this gear is driven by a pinion **56** secured to one face of large gear **57** whose peripheral teeth are driven by a pinion **58** on the shaft of reversible motor **59**. Bearing on this pinion may be a friction spring **60** secured to a fixed post in the hull to hold the motor for the fins stationary when not energized. Obviously, this type of gear arrangement can be consolidated into the shell of the motor, if desired, or some other form of reduction gears such as worm and wheel used to convert the high speed of rotation of the motor to a relatively low speed for control. No spring brake is needed for a worm and wheel reduction. In case it is not desired to use a reversible motor, the wheel **55** may be allowed to rotate through 180 degrees, when it will commence to move the fins in the opposite direction. Obviously, when the fins are tilted with their forward edges downward, the craft dives and vice versa. For surface operations the fins should be horizontal.

Control for the several motors is achieved through the control box **65** located near the source of power. The showing is only exemplary, includes an "on" and "off" switch **66** for connecting the source of power to the propulsion motor **30**, and for this can be substituted the conventional rheostat in case it is desired to have the craft move at adjustable speeds. A so-called three-way momentary contact switch **67** is arranged near the center of the control box panel and preferably pivots on a fore and aft axis so that when moved from the neutral or "off" position in the center, to the "on" position on the right it energizes the rudder motor **36** so as to turn the craft to the right, and vice versa when it is moved to the left. Such a switch returns automatically to the "off" position so that brief contact closure for accurate steering is readily available.

A similar switch **68**, but tilting fore and aft, provides the controls for the motor **59** which operates the diving fins. All of the control wires are preferably cabled as shown at 62 in FIGURE 1 and enter the craft just aft of the conning tower 18, for with this center or neutral position cable drag has less effect on the course of the craft in the water than would any other.

In some cases it may be desired to eliminate one of the steering motors, preferably the one handling the diving planes, in which case the alternative arrangement shown in FIGURE 6 may be made use of. Here two separate cables 70 and 71 from the controls for motors 30 and 36 not only carry current, but also enable the operator to manually manipulate the controls for the diving planes, to which end they are attached to opposite ends of the horizontal member 70 of a bell crank lever, pivoted at 73 on a cross shaft in the hull, which is connected through a vertical arm 74 and the link 75 to an arm 76 on the cross shaft 52 of the diving planes 50. Thus, a pull on conductor 70, only, lifts the forward edges of the diving planes and causes the craft to rise, if it has been submerged, while pull on conductor 71, only, will cause the craft to drive. This gives the operator some sense of manual control and may be preferred in some cases.

In any event, the driving fins, as illustrated in FIGURES 1 and 2, are fitted with vertical stabilizer planes 80 which are perfectly flat sheets of metal secured preferably to the upper faces of the fins 50, but they could just as well be mounted beneath. They extend not exactly fore and aft, but more nearly straight than the sides of the submarines adjacent the fins as shown. They act to stabilize the bow of the craft against lateral displacement resulting from the effects of waves or wind and result in minimum yaw in rough water.

It will be appreciated that the present invention provides a toy submarine that is readily maneuverable so that it can be directed forward or made to turn left or right in any desired size arc by a mere touch of a switch. Likewise, it can be made to dive or surface deeply and quickly or as gradually as desired. The depth and distance to which the craft can go is determined only by the length of cable between the control box and the boat and the area and depth of the water available.

As seen in the drawings the rudder and propeller are elevated above the rather sharply curved midship bottom surface of the craft and are thus protected from striking the bottom and yet the submarine may be made to maneuver along the bottom with ease. With the source of power on shore, or in a boat occupied by the operator, the total weight of the submarine can be kept to a minimum and particularly since the hull is open to access by water and air reducing to a minimum the buoyancy not being supplied by the flotation material.

A toy submarine of the type described is rugged, relatively low in cost and will provide the user with a great amount of pleasure because of his complete control of its realistic operation.

I claim:

1. A toy submarine boat including in combination a thin hull shell, electric propulsion means and electric rudder control means in and carried by said shell, means ballasting said hull arranged near the lower portion thereof, flotation means in said hull near the upper portion thereof, apertures in the upper and lower portions of said hull in comunication with each other for the entrance of water into said hull through the first-mentioned apertures and the exit of air therefrom through the second-mentioned apertures whereby said flotation means alone keep the boat afloat with a predetermined load water line when stationary, diving rudder means extending from the forward portion of said hull below said water-line and adapted when the boat is in motion under the action of its propulsion means to be adjusted to cause the boat to dive below the surface, and remote control means for individually controlling said propulsion means, said rudder means, and said diving rudder means.

2. A toy submarine as claimed in claim 1 in which fixed fins extend laterally from the hull substantially aft of the diving rudder means to provide longitudinal stability and resistance to rolling.

3. The toy submarine as claimed in claim 1 in which the hull has a bow section tapering to a relatively sharp prow, and the diving rudder means includes a fin extending laterally and having an edge conforming to each side of the hull along the tapering forward end thereof, means supporting said fins for tilting about a horizontal axis transverse to the vertical median plane of the hull, and a vertical fin secured to each diving fin, said vertical fins being plane and converging toward each other less than the taper of said bow section.

4. In a toy submarine a thin hull formed of sheet material to a generally elliptical cross-section tapering from the center towards bow and stern, the major axis of the ellipse being horizontal, the stern under section being raised to accommodate a propeller and rudder, a raised deck portion extending along the top center for most of the length of the hull, buoyant material in the upper portion of the hull, ballast in the lower portion of the hull, apertures in said lower portion of said hull communicating with apertures in said upper portion of said hull for entrance of water into and exit of air out of said hull, said buoyant material and ballast being adjusted for normal flotation with substantially only the raised deck section exposed above the water surface, driving means in said hull for said propeller, diving rudders at the forward part of said hull and remote control means for controlling said driving means and for adjusting said diving rudders whereby the submarine may submerge as a result of its forward motion.

5. A toy submarine as defined in claim 1 wherein said diving rudder means comprises a shaft extending therethrough, an arm extending normally to said shaft, an electric motor having its axis of rotation parallel to said shaft, a reducing gear train driven from said motor shaft and including a final gear pivoted adjacent to said arm and on an axis parallel to the motor axis, a sleeve slidably mounted on said arm and means pivoting said sleeve to and adjacent one face of said final gear for adjusting the arm and rudder means as the motor is rotated.

6. The toy submarine as defined in claim 5 in which a spring is arranged to be engaged by teeth of one of the gears of the train to frictionally hold the rudder means in an adjusted position when its motor is not energized.

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