Oct. 16, 1945. N. M. HOPKINS 2,386,950

MEANS FOR PROTECTING SHIPS AT SEA

Filed Jan. 20, 1943 6 Sheets-Sheet 1

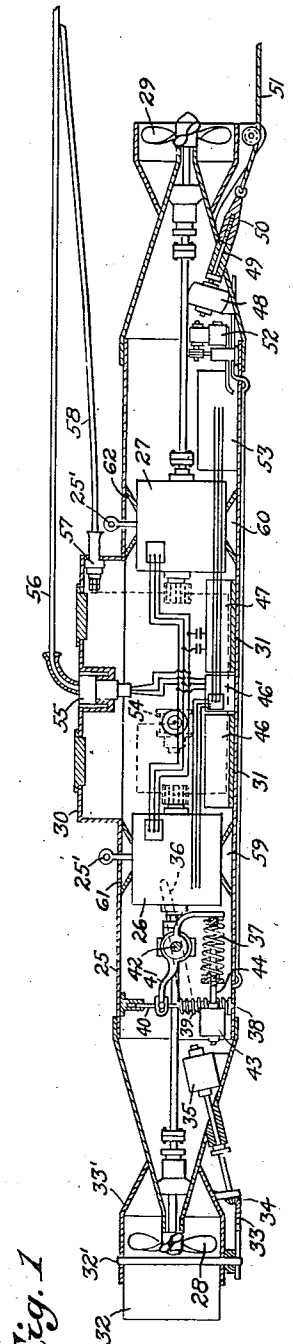

Fig. 1

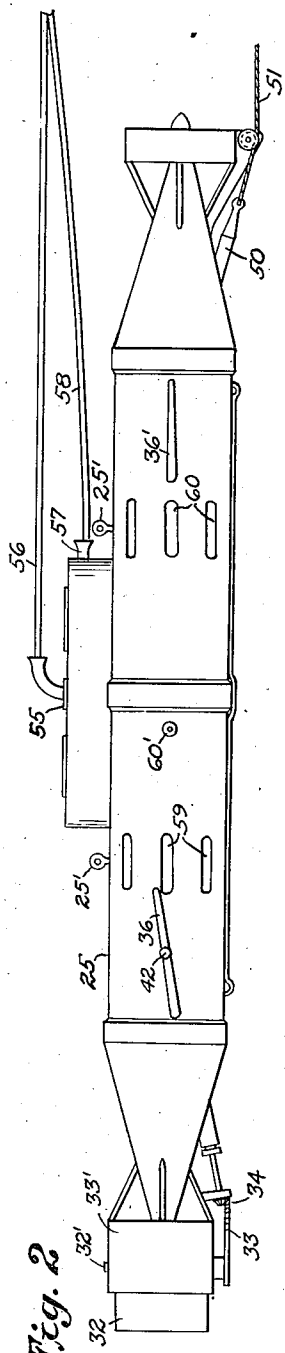

Fig. 2

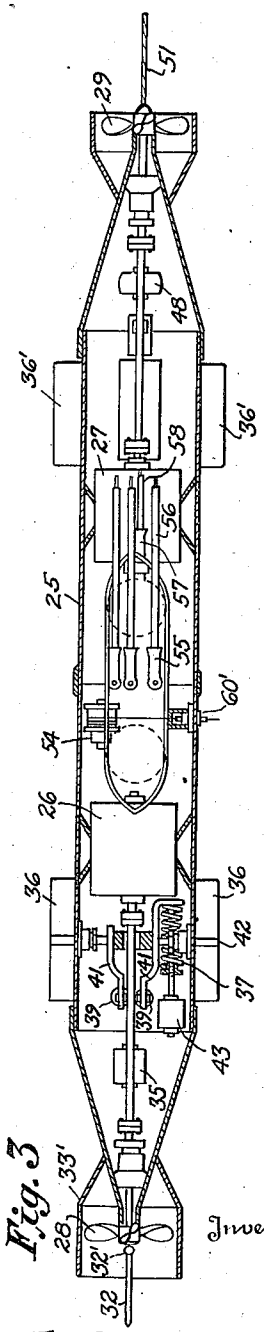

Fig. 3

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MEANS FOR PROTECTING SHIPS AT SEA

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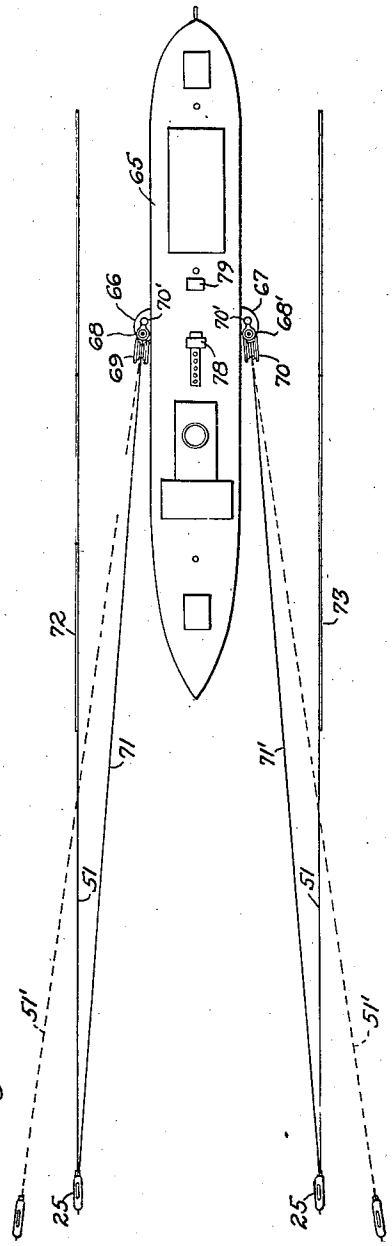

Fig. 4

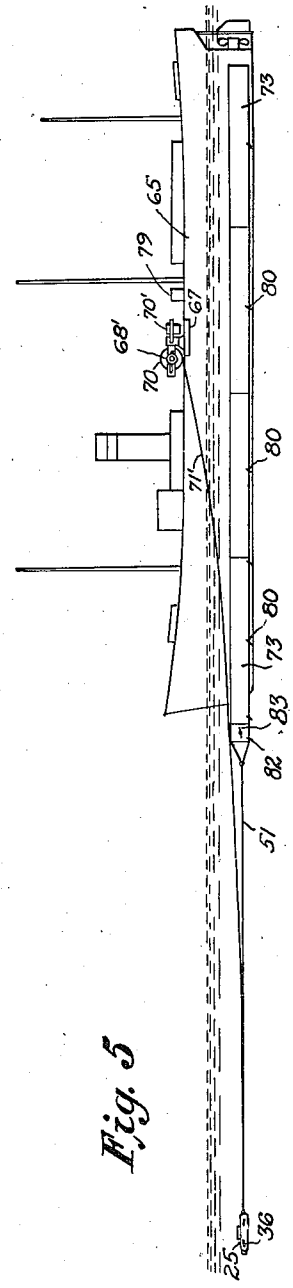

Fig. 5

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MEANS FOR PROTECTING SHIPS AT SEA

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Fig. 6

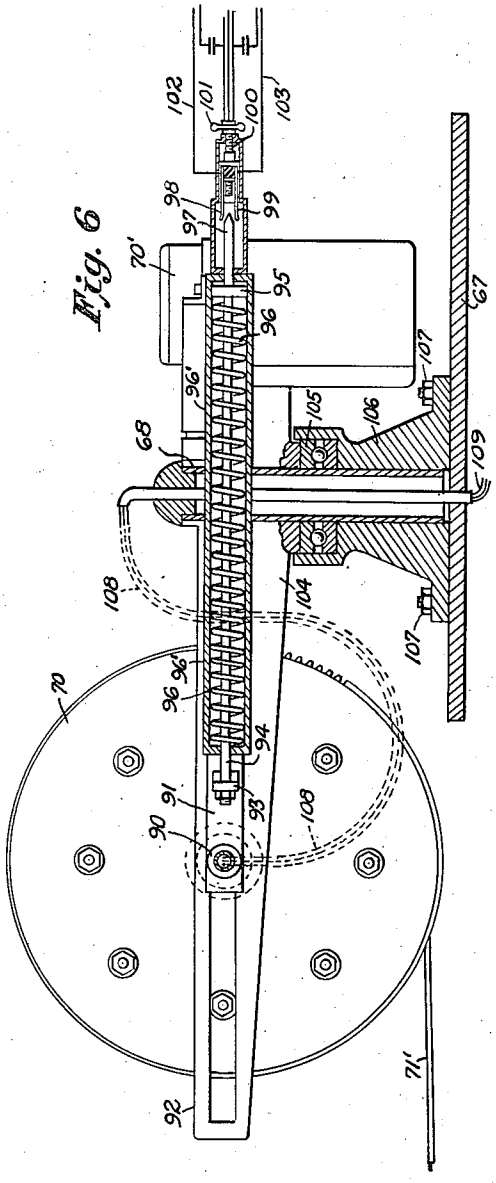
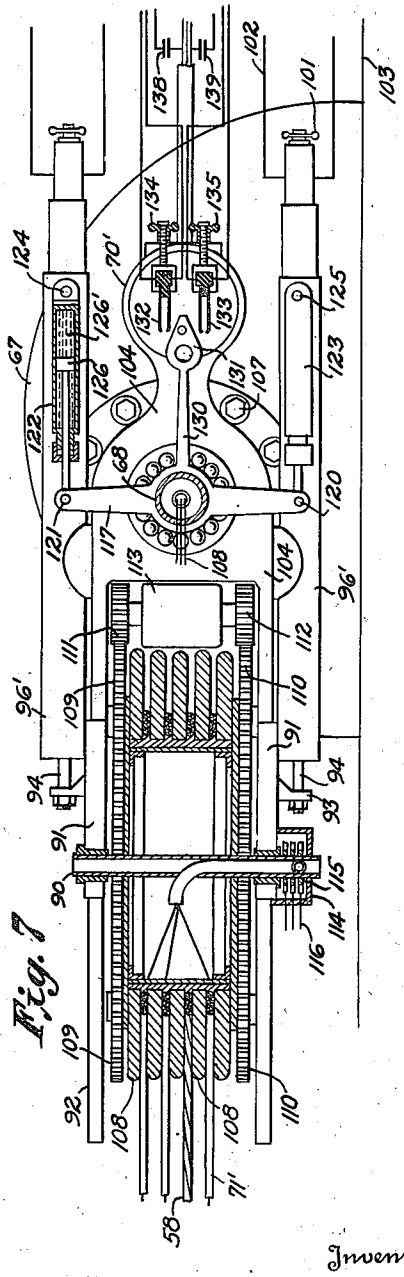


Fig. 7



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MEANS FOR PROTECTING SHIPS AT SEA

Filed Jan. 20, 1943 6 Sheets-Sheet 4

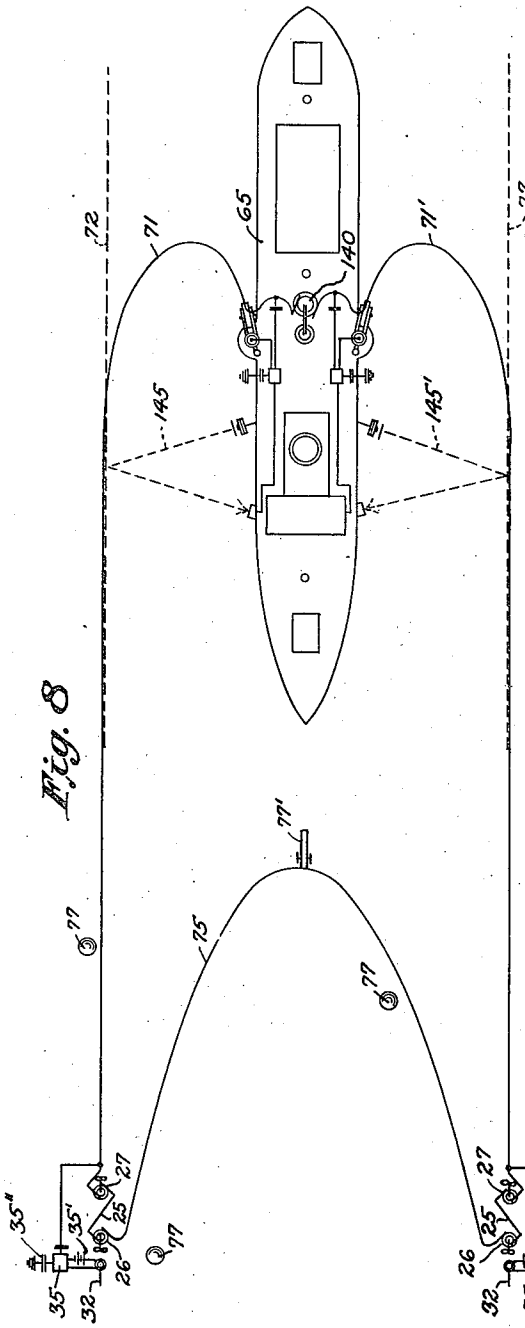

Fig. 8

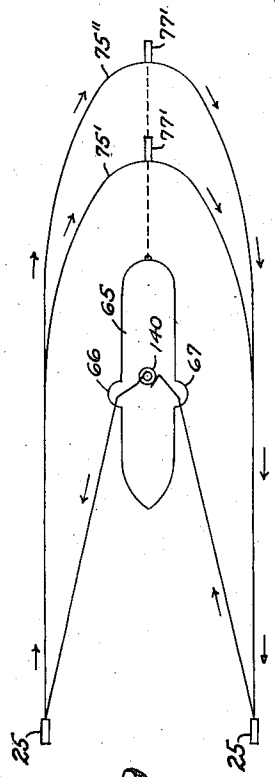

Fig. 9

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MEANS FOR PROTECTING SHIPS AT SEA

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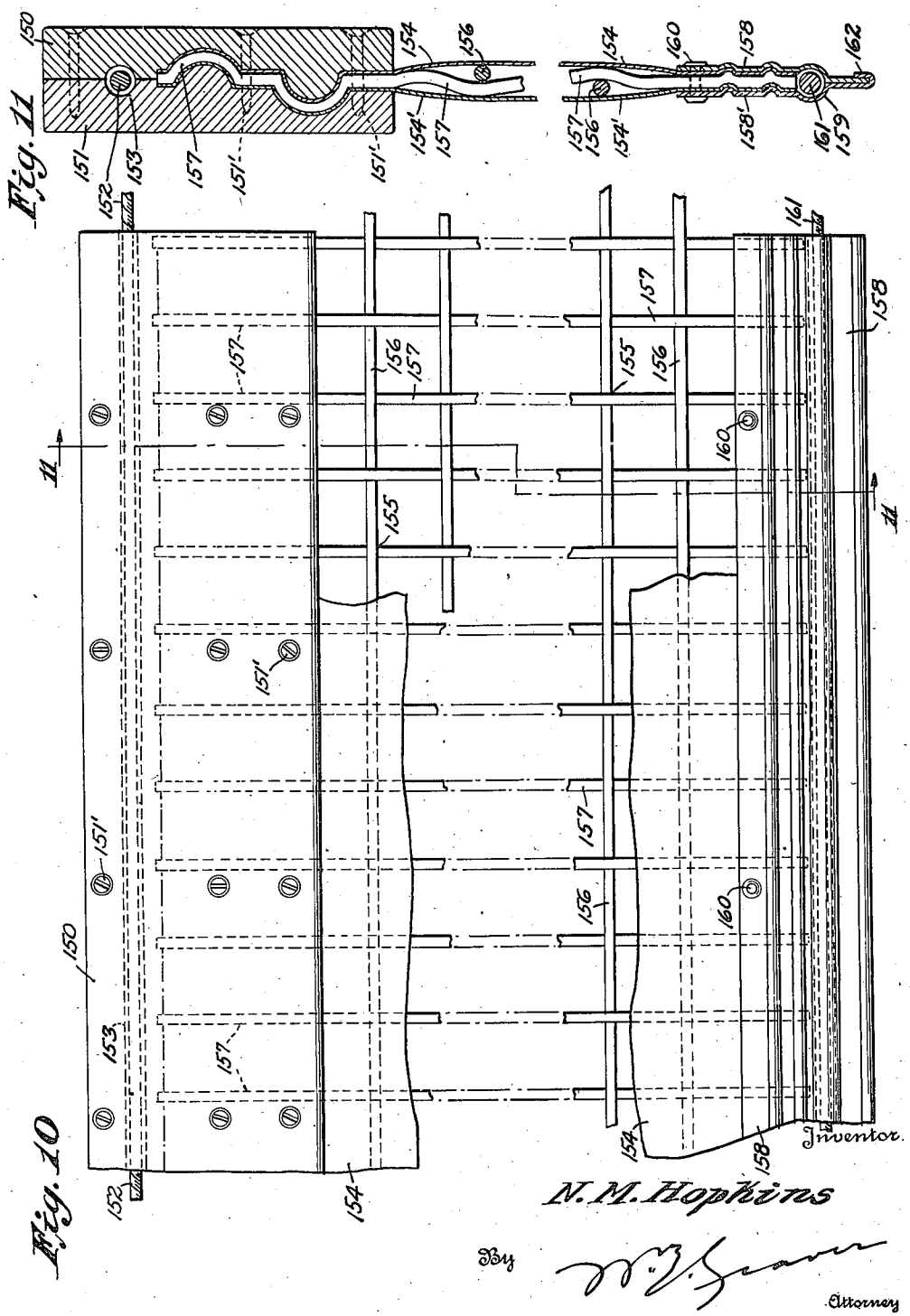

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MEANS FOR PROTECTING SHIPS AT SEA

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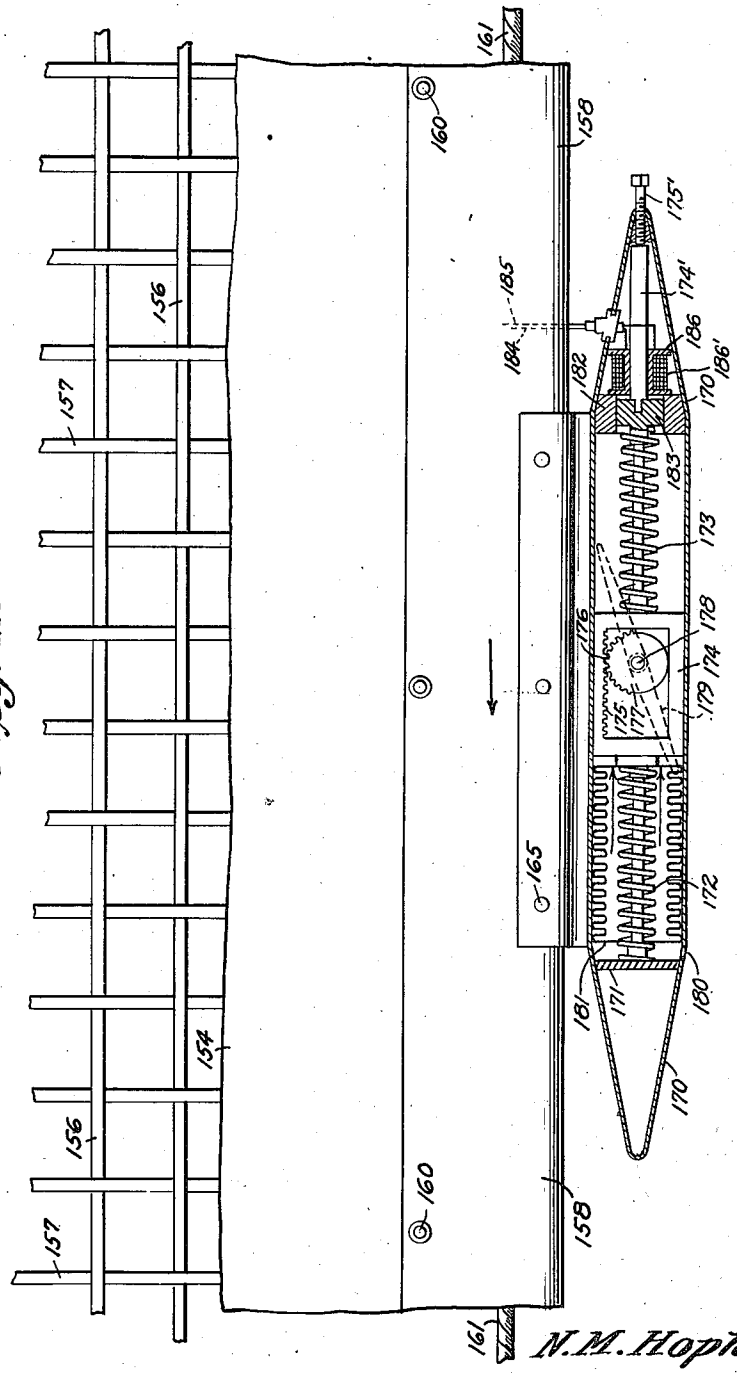

Fig. 12

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Patented Oct. 16, 1945 2,386,950

UNITED STATES PATENT OFFICE

2,386,950

MEANS FOR PROTECTING SHIPS AT SEA

Nevil Monroe Hopkins, New York, N. Y.; Raymonde B. Hopkins executor of said Nevil Monroe Hopkins, deceased

Application January 20, 1943, Serial No. 473,010

19 Claims. (Cl. 114—240)

This invention pertains to new methods, ways and means of protecting the hulls of ships against submarine discharged, and plane launched torpedoes, and certain types of mines, the magnetic mine in particular, under all normal conditions of wind and sea, this invention comprising not only the protection to a ship equipped against the magnetic mine, but also the protection to a ship following in its wake, by means of a magnetic loop towed astern.

It is an exceedingly important major object of this invention to provide deep torpedo protection and deep magnetic mine protection, through net or belt-like devices and equipment capable of navigating with the ship, well below the roots of waves, for several vitally important reasons—to avoid being smashed by the forces of the wind and sea and to reach deeply moored magnetic mines and deeply launched magnetic-warhead fish torpedoes, for example.

It is also an important object of the invention to carry the protective belt equipment farther from the hull of the ship than heretofore possible with booms and paravanes, thereby giving protection against the most powerful super-torpedoes now in use or in the making.

It is also an object of the invention to provide counter-magnetic mine electro-magnetic fields well in advance of a ship in times of gale, when radio controlled surface launches or aeroplanes electro-magnetically equipped could not operate.

It is also an important object of the invention to provide a barely floating "electric towing fish" device and a barely floating net or belt device when at rest in the water of the sea, both fashioned to be sent, by remote control from the protected ship, to one or more depths below the surface of the sea at a predetermined speed of navigation, through aquaplane means, capable of slowly stopping or turning aside a fish torpedo without exploding it, and therefore protecting the hull of a ship against one or more torpedoes launched successively, one behind the other.

It is also an important object of the invention to provide novel designs of counter-balanced, motor operated winding drums for the cables of the power and wired radio control circuits, capable of insulating the cable, and yieldably paying out and anchoring the cable, respectively, and of controlling the angle of leads of the cables with the sides of the ship, to control the pull of the electric fish by speeding up or retarding them. Therefore, there is contemplated the steering of the electric fish and the maintenance of belt position in the sea, as well as the depth and speed control of both, tension on the cables, and the provision for comparatively small angles of cable lead from ship to electric fish, in order to establish and maintain a minimum of lateral cable drag in the sea as well as to conserve useful deck space for cargo.

It is a further object of the invention to employ wired, or guided radio, some times called carrier current radio for the control of the "electric fish" from the ship using the angular displacement of the winding drum carriages, as well as the power cables for the purpose.

It is also an object of the invention under certain conditions to employ the wired or guided radio for purposes of remote control using both the cables and the salt water of the sea as conductors for the carrier currents.

With the foregoing objects in view, as well as certain additional objects made possible by modern engineering methods, which will become apparent as the description proceeds and the drawings are studied, the invention resides in the novel and useful designs of apparatus and combinations of apparatus and equipment, as well as scientific principles all as hereinafter set forth and particularly covered by the claims.

Referring to the accompanying illustrations forming a part of this specification and in which like numerals designate like parts in all the views:

Figure 1 represents in partial vertical longitudinal section and partial elevation, one design of my "electric fish" for comparatively quick manufacture using standard types of electric motors, for the towing of a submerged anti-torpedo belt for ships at sea, and/or an electrical conductor for establishing a magnetic field for exploding magnetic mines planted in the sea.

Figure 2 is a side view of this "electric fish" in elevation.

Figure 3 is a partial horizontal longitudinal section and partial elevational top or plan view of this fish.

Figure 4 is a top plan view of a small cargo vessel under way, equipped with one design of my submerged electric fish, belt device, winding drums and other devices of the system for protection against torpedoes launched by aeroplane or discharged by submarine, with its possible auxiliary anti-magnetic mine feature.

Figure 5 is a side view of this cargo vessel underway, so equipped, indicating the sub-sea surface navigation at one possible selected depth, of the combined "electric fish" and protective belt.

Figure 6 is a side view in partial section design

of one of my stanchion supported yieldable, motor operated winding drum for angular control of multiple cables, tension regulation, and the like in the water of the sea.

Figure 7 is a top plan view of this drum device in partial section.

Figure 8 is a top plan view of a small cargo vessel under way, equipped with an alternate design of my submerged "electric fish," simplified cable and winding drums therefor, torpedo protective belt device and anti-submarine development.

Figure 9 illustrates an alternate magnetic mine-sweeping plan.

Figure 10 is a short section of one design of my "barely floating" compound canvas sheathed anti-torpedo nets, cut through the center to save space in its illustration.

Figure 11 is a transverse sectional view of the net, taken as on the line 11—11 of Figure 10.

Figure 12 is a short section of the lower edge of this device, showing in section one of my automatic depth controlling aquaplanes, with schematic indication of an electro-magnetic remote control gear for changing the depth of navigation at will.

With further reference to Figure 1.

25 represents a small submarine boat or "electric fish" fashioned to lead a ship at sea and be electrically operated by remote electric power. This electric power, transmitted through cable from the ship it protects, is greater than any source of power possibly inherently generated in the "fish." The power required has not only been calculated from "skin friction" and other engineering data, but checked by actual experiment and reduction to practice with models. The "electric fish" has also been carefully calculated to have a positive buoyancy when at rest in the salt water of the sea at a suitable temperature, and fashioned to be forced below the surface of the sea to automatically regulated and adjustable depth by suitable aquaplanes and gear devices when under way with its cable loads and other factors.

Here **26** and **27** are standard commercial electric motors, drawn substantially to scale, connected directly to the propellers **28** and **29** for right and left hand drive, respectively, through customary couplings, shafts, stuffing boxes and thrust bearings, thereby eliminating any undue tendency to rotate the electric fish about its longitudinal or major axis. What slight rotating torque one motor and propellor may have over the other being cared for by a proper stability of the "fish" due to a suitable metacentric height of the whole structure, secured through the agency of the buoyant superstructure **30** and the metal ballast castings **31**, **31**, as well as the placing of certain auxiliary motors, **35**, **43**, **52**, **48**, and gear as shown below the central axis of the casing **25**. The size of this "electric fish," here illustrated roughly to dimensions, is of the order of 40 inches in diameter and 32 feet overall length, has a sea water displacement of about 13,000 pounds and houses and floats a pair of three hundred horse power motors.

When the "electric fish" is confined to the towing of an anti-torpedo belt device as later illustrated and described, the motors **26** and **27** may be of the simple induction, "squirrel cage" type using three-phase alternating current, but when for the combined purpose of towing the belt device and a countermagnetic mine "loop" the motors are preferably of the direct current, series connected design as indicated partially by dotted lines indicative of commutators and the necessary brush gear. These motors **26** and **27** may well be of "railroad" type where the armatures and fields are series connected, for example, or they may be of universal type for either direct or alternating current with laminated fields in series with armatures, each having a speed of 1800 R. P. M. In an alternate design I have planned for two motors, one with a hollow shaft gear, for example, to enable me to have the pair of turbine type propellers at the stern of the fish instead of one fore and one aft, as illustrated here, but I have compromised in this design to enable one to quickly use standard motors for the purpose to save valuable time in securing them.

In this design of "electric fish" the rudder **32** is placed at the bow, in order to give powerful steerage, since the pull of the protective belt cable is well aft and a rudder at this zone would be less effective due to the tension there. This rudder is turned by the quadrant of the bevel gear **33**, by the bevel pinion **34** and the reversible electric motor **35**. The rudder post **32'** is conveniently supported in the open bell end **33'** which is fashioned to guard the propeller and at the same time to allow the water of the sea to flow freely through. It may be pertinent to state here that by giving the bell end a bell flare by increasing its diameter just ahead of the leading propeller, increased duty is imposed upon it. Since this "electric fish" is in effect a submarine, there is little danger of surface floating debris getting into the leading propeller. Small fish would be quickly cut to pieces, but as previously stated this design has been illustrated to bring out the fact that no special hollow shaft or gearing is necessary in the design, where time is the essence.

The electric motor **35** may of course have additional reduction gear between its shaft and the bevel gear **34** and is fashioned to rotate clockwise or counterclockwise at will, receiving current through step down transformer or storage battery (not shown), and controlled by a set of relays, wired radio filters, amplifiers, reversing switches and the like (not shown), all responsive to carrier currents generated by oscillators on the convoyed ship and sent over the power cable by automatic switch gear on the angle controlling winding drum presently illustrated and described in detail.

It is well known that radio waves may be guided by metallic conductors between a transmitter and a receiver instead of being allowed to radiate freely through space. This system therefore is ideal for the purpose in hand. As a matter of pertinent collateral interest in this connection, it may be stated that energy waves may thus be transmitted distances up to twenty times as great as those attainable without the assistance of the guiding cable. Conversely it is obvious now that for short distances greater power is available for the control. With proper selection of radio frequencies between, let us say, 20,000 and 500,000 cycles, there is absolutely no interference with the low frequency of the current in the power cable, which may be of the order of from 60 to 400 cycles.

By proper selection of frequencies for the application of power impulses or signals to the "electric fish" over the power cable, so that the side bands do not overlap, and so there is no interference between their harmonics, it is possible

to use conductors of the power cable, whether of alternating current or direct current type, for carrying different power impulses at one time, each power impulse using one of the selected frequency channels. These power impulses, of course, amplified at the "electric fish" for any number of duties apart from the all important one of steering. Among collateral duties which may be imposed may be mentioned variable depth control of the "electric fish" to meet the requirements of variable wave height and depth of root. Radio wave energy has been successfully transmitted over telephone, telegraph and lighting circuits, trolley lines and power lines of all kinds for many years. Applicant has the promised co-operation of a nationally known radio engineering design and manufacturing corporation for the reducing to practice of his remote control by carrier current of the "electric fish." Complete wired radio diagrams not shown.

The depth controlling aquaplane 36 shown in dotted lines in the present view is controlled as schematically represented by the compression spring 37 and the pressure of the water of the sea, respectively, entering the opening 38 in the open base of the metal bellows 39, and the guided piston 40 and the double lever gear 41 on the aquaplane shaft 42.

The electric motor 43 is, like the steering motor 35, fashioned to reversable switch gear and relay operation by carrier current and wired radio as previously set forth, for giving the "fish" a variable depth navigation. From an inspection of this gear it will now be appreciated that the power of the spring member 37 may be increased or decreased at will by remote wired radio control by the operation of the motor 43 whose long threaded shaft 44 (threads not shown) advances the threaded cheek member (threads not shown) against an end of the spring member 37.

Variations in the spring compression, it will now be seen, allows the pressure of the water of the sea in the metallic bellows to move the aquaplanes through a more or less angular degree, and therefore to give a greater or less sub-surface travel or navigation of the "fish." Since the aquaplanes are pivoted centrally, and since therefore the water pressure impressed upon both sides is equal when the "fish" is under way in the sea, it requires but little power to alter and hold the angle of lead. Applicant has shown this to be a fact with the model reduction to practice which he has carried out.

The cases 46, 46' and 47 contain step-down transformers, storage batteries and control apparatus as well as servicing equipment and supplies (not illustrated in detail, but necessary or desirable in the operation of the fish).

48 is a small electric motor fashioned to be operated by power from the cable or a storage battery and controlled by a filter, relay, switch and the like by carrier current for rotating at will by remote control its threaded shaft 49 and thereby releasing the threaded draw-bar member 50 which acts as the connecting towing member for the cable 51 attached to the leading member (not shown in the present illustration) of the protective belt. This motor operated device to enable a ship's master to release the protective belt at any time and thereby possibly cast it adrift should he ever wish to do so. It has been learned that some sea-faring men might wish to have such a ship clearing gear. Here 52 is a motor driven sump-pump for removing any sea-water which may enter the casing 25 of the "electric fish" through stuffing boxes, manhole covers, cable entrances and the like through the system of piping substantially as illustrated, and 53 is the casing containing the necessary control equipment and supplies for this sump-pump, and such other gear necessary to the operation of the "electric fish."

54 is a motor operated winding drum for the interconnecting stranded cable or wire for counter magnetic mine work, as will be clearly dealt with in subsequent views. 55 is a water-tight revolvable insulated strain anchor for a power cable 56, and 57 is a fixed insulated strain insulator for the cable 58, which may or may not be an electrical conductor, according to the particular design of system employed. Where direct current is employed instead of three-phase alternating current, the system is simplified, the cable 58 being a combined electrical conductor and strain cable, the conducting metal or copper in this cable having a steel core. Such a cable is commercially known as a "copperweld" and "copperweld-copper" conductor, having tensile strengths of from 2 to 2½ times the strength of hard-drawn copper. The compound conductor comprises a thick weld-on covering of copper, which gives the high strength of steel without danger of rusting in the salt water of the sea. The electrical conductance is the best obtainable of any high tensile strength conductor and the applicant has full necessary data for the power transmission requirements. 59 and 60 are openings into the steel shell 25 in order that cooling sea water may contact the housings of the motors 26 and 27 when they are too small to fit snugly into the shell, being held by the welded members 61 and 62.

It is deemed of pertinent interest to state that these motors are heavy duty variety, glass and asbestos insulated, with bearings of ball or roller type packed in heavy grease, for long voyages without attention.

In addition to the air fan cooling or/and water cooling, a water circulating pump may be added for each motor (not shown for simplicity). The voltage of the present 3-phase induction motors is of the order of 2200 volts, and the current may be standard 60 cycles. The diameter and pitch of the propellers have been worked out to operate direct connected at 1800 R. P. M. for various speeds of cargo vessels and the horse powers required to tow the belts, all based upon actual and practical data in hand. But a full engineering exposition would be outside of a patent specification. Suffice it to say, however, that for two three hundred horse power motors, as illustrated, in the present "electric fish," a pair of 30 inch turbine propellers 14 inch pitch, three blade, on 2 inch diameter shafts, would not be far from the correct mark for a 10,000 ton 12 knot freighter, and its protective belt.

With further reference to Figure 2.

Here it is pointed out that the movable aquaplane 36 on its shaft 42, adjacent to the forward end of the fish, is substantially centrally pivoted in order that the water pressure of the sea is substantially the same upon an area before and aft of the shaft, thereby rendering it easy of angular control. In other words no undue turning effort is required of the metal bellows gear to hold or alter the angle of the aquaplanes when the "electric fish" is under way in the sea. Actual experiment with models by the applicant has shown that this simple method of depth control is correct, but it is barely possible for the full sized

"electric fish," that electric motor control may be more desirable, in which case working data may be easily obtained. In this view it is also pointed out that the twin aquaplane **36'** is fixed adjacent to the rear end of the fish, and experiment with a power driven model submarine towing a model belt has shown that a pair of such fixed aquaplanes are quite essential in view of the mechanics of pull and other forces at work, of the entire submerged system. The angle and area of these fixed rear aquaplanes **36'** has also been found by experiment to be important, especially important in connection with the applicant's design of leading rudder for the "fish."

In his model reduction to practice applicant has many data of interest and value in connection with the submarine belt system, but it is deemed to be outside of this specification to indicate them all here.

The multiplicity of openings **59** and **60** through the shell of the "fish" is, as stated, to allow the cooling water of the sea to carry away the many thermal units of watt dissipation of the electric motors, transformers and the like within the shell of the "electric fish."

The opening **60'** which may, or may not, comprise an insulating bushing, and which is centrally located as will be seen, serves for the entrance or exit of a cable or wire for the series connection of the motors in the two "electric fish," and also as the source of a magnetic field in the sea capable of operating the magnetic mechanism of a magnetic mine. The eye bolts **25' 25'** are suitably screwed into the field casings of the electric motors, to afford approved lifting points, if, as and when it may be desired or required to hoist the "electric fish" out of the sea and to swing it upon davits or the like.

With further reference to Figure 3.

Here it is believed that the features in the two foregoing views are made additionally clear and that further description is not necessary since like parts bear like numerals in all of the illustrations.

With further reference to Figure 4.

Here **65** is a plan view of a ship equipped with my proposed stanchions, or projecting platforms **66** and **67**, which may be pre-fabricated and be quickly bolted to the sides of a ship. They are somewhat analogous to small gun platforms as applied to gun-boats and cruisers, but instead of pivotally mounting a gun carriage for angular sweep, they pivot at **68** and **68'** substantially counter-balanced, yieldable, angle-controlling, motor-operated winding and paying out drums **69, 70**, with the counter balance members **70', 70'**, each drum fashioned to receive one or more cables **71, 71'** for supplying electric power and carrier currents to the submerged "electric fish" **25, 25**, which "electric fish" tow the submergible and submerged torpedo belts **72** and **73** by means of the cables **51, 51**. As previously stated, upon wired radio impulse of proper selected frequency, electric motors in the "electric fish" may be made to unscrew and release the belts, one or both, from the "electric fish" at the will of the skipper on the bridge of the ship **65**.

The skipper may also, through the means of hand gear on the winding drums **69, 70** (not shown here but in a later figure), send the "electric fish" further out into the sea, as indicated in the dotted lines **51', 51'**, whether they are towing torpedo belts or not. In the drawings no torpedo belts are shown in the furtherout position, because applicant may tow one of a number of alternate protective devices. For example, applicant may tow one of the compound net sheathed belts as later illustrated and described in detail, or he may tow a large meshed steel net fashioned to ensnare the tail of a torpedo in the act of passing through. Such a large meshed steel net offers less towing resistance than a compound belt, but it has the disadvantages of possibly fouling a screw propeller on making a hard port or a hard starboard turn, and in addition could fail to ensnare a fish torpedo by the tail if said tail is properly guarded in the future.

Applicant may also elect to tow an explosive device fashioned to detonate the explosive in a torpedo warhead when it approaches the device or contacts it. Such an explosive device fashioned to be towed will be more fully described later in this specification.

Still another alternate device would be a loop, towed well out from the sides of the ship and well astern thereof for successively tripping the mechanism in a magnetic mine. Another alternative would be long cables electrically conducting direct currents for counter magnetic mine destruction. All of these alternate devices would require less towing power and consequently smaller "electric fish."

For such comparatively small "electric fish" a small steam turbine operating a generator could well be run with a minimum of space by taking steam from the ship's boilers.

Electric power, either alternating current three phase, 60 cycle, or direct current, is generated by the Diesel engine generator set **78**, and can be supplied to the cables **71** and **71'** by suitable regulating gear and leads (not shown in the present drawings). In this Diesel engine drive, the speed of the ship at sea is not reduced. The weight of the Diesel engine generating set is negligible in the matter of the ship's displacement. In other words 150 tons or more in a 5000 or 10,000 ton ship would not affect her speed as much as a slight change in the temperature of the sea in which she navigates. The addition of the slight excess power over the towing power required of the belts would of course tend to increase the speed of the ship. The electric power may be supplied, however, by a steam driven turbo-generator set, in which case there would be a reduction in the speed of the ship, or the power may be taken from the steam electric drive of a ship by a simple "bleeder" system.

In the case of taking power from the ship's electric drive it may be stated that in many cases the boiler plant may well stand this extra demand without reducing materially the ship's speed. Again it might be simpler to add an auxiliary boiler than to add machinery—a Diesel electric generating set, for example, if this was found necessary on close calculation.

At **79** is a complete duplicate set wired radio transmitting equipment for sending carrier currents at different selected frequencies over the power cables, or over the power cables and salt water of the sea, comprising oscillators, condensers for selective current transmitters and the like for the remote control of the mechanisms in the "electric fish" as already described. The wiring or connection to the winding drums on the power cables and the grounds to the sea are not shown in this figure.

With further reference to Figure 5.

Here the important scheme of one of the pair of stanchions and counterbalanced, motor operated, pivoted, yieldable, angle controlling, winding

and paying out drums 70 is made clearer. The counterbalance member 70' not only counterbalances the drum, but the cable extending into the sea. The drum is restrained against sudden or short duration pulls of the cable and other disturbances, as from the roll of the ship, by hydraulic check cylinders not shown in the present view but illustrated in a subsequent view.

With the present ship 65 under way, the electric fish 25 and the protective belt 73 are shown below the level of the sea, both being capable of being sent still lower—below the deep troughs of the waves of the sea—in stormy weather.

Both fish and belt therefore are not only automatically regulated for fixed depth of navigation, but are controllable for variable depth of navigation by remote control through the agency of carrier currents in the wired or guided radio.

The "electric fish" has the pair of controlling aquaplanes, one of which is shown here at 36, and the belt device, later described in detail, has a plurality of automatic depth controlling aquaplanes 80, 80, 80, presently illustrated and described in detail. The rudder member 82 of the forward end of the belt 73 is equipped with a pair of stabilizing pivoted aquaplanes 83, operated by a gyroscope driven by cable power or storage battery, to insure vertical position in the sea when under tow, or by mechanical means comprising a pendulum hinged to a beveled pinion, which turns a pair of bevel gears, respectively, turning port and starboard aquaplanes, all as illustrated and described in a brochure entitled "New Torpedo Proof Convoy for Freighters at Sea," written by the present applicant and a matter of record at the Massachusetts Institute of Technology, Johns Hopkins University, and Stevens Institute of Technology.

Of course applicant has given due attention to the power required of his "electric fish" to tow such a belt 73 of various widths, and lengths, and at various speeds in the sea, taking into account the power required for the depth controlling aquaplanes. This has involved a study of the values of skin frictions, not only of ships, but of various materials considered for the sheaths of his net enclosed belts. The belt is adjusted to be barely floating when at rest, therefore the aquaplane exertion, and consequent power therefor, to overcome the aquaplane exertion, is not great. The fact has been well determined by applicant's model belts. Also engineering calculations have been made of the resistance to towing of a smooth surface in salt water, based upon William Froude's classic formula:

$$R=fsv^n$$

where

R=resistance in pounds
s=area of both sides
f=coefficient of friction
v=knots
n=1.83 exponent

See Taylor's "Speed and Power of Ships."

The "smooth surface" of applicant's sheathing for his nets consists of canvas that has been painted with one or more coats of "metallic marine paint" and then "simonized" or treated with paraffin, and well rubbed down. A paraffined surface is one of the least resistant, according to extended researches, to towing in the salt water of the sea.

The drawings, details of which will be shown in subsequent views, have been made from model belt construction, which construction lends itself to any desired width of belt—from let us say, for example, 8 to 12 feet or more.

An eight or ten foot belt "navigating" 15 feet below the surface of the sea is as effective a barrier to the fish torpedo, it will be appreciated from the present illustration, as a much wider belt with its upper edge at water level, and, of course, the narrower the belt for any given length, the less will be the skin friction and consequently the power required to tow it.

Thus it may be seen that the ship 65 may wallow in a heavy sea, with the minimum of strain and stress upon the cable 71' and with practically no strain and stress upon the deeply submerged or submergable "electric fish" and protective belt.

With further reference to Figure 6.

Here more or less schematically represented is a side view of one of the large winding drums 70 slidably or yieldably mounted through the agency of its hollow axle 90 and sliding bearing member 91 in the long slotted guideway 92, which bearing member is resiliently held back toward the hollow central pivoted shaft 68 by means of one of a pair of lug members 93, and the long bar members 94 and the distant head member 95 and the long compression spring 96, in the long cylinder 96'.

The long bar member 94 terminates in the conically turned end 97 fashioned to make an electrical circuit closure by contact with the adjustable spring members 98 and 99 fashioned to be moved forward or backward by the screw 100 and its hand wheel 101. Electric current in the conductors 102 and 103 may be made to flow therefor when the conical end 97 of the long bar member 94 recedes. The conductors 102 and 103 lead to a source of electric current and a proper power controlling device for current to the aforesaid mechanical "electric fish."

The hollow shaft 68 is stationary with the pedestal 106 secured to the platform or stanchion 67 by the bolts 107, said shaft extending upwardly through the carriage 104 for the winding drum, which carriage rests upon the heavy radial and thrust bearing 105 recessed in the upper part of said pedestal.

A flexible insulated electric cable 108 extends from the connections to the cable in the drum 70 to and down through the hollow central pivot shaft 68 and is conveniently available in a stationary anchorage at 109 for connection to a suitable source of electric power for the propulsion of the motors of the "electric fish" in the sea.

With further reference to Figure 7.

Here the drum is shown in partial section to show the reception of four cables—three insulated copper or copper weld steel, power transmission cables, and one bare steel tension cable, possibly consisting of copper plated strands or impregnated with anti-rust compound, for removing all under strain from the insulated copper cables.

This deep winding drum comprises a liberally large diameter of inner barrel around which the cables wrap, not only to provide a proper bending radius for the cables, but to provide for a maximum length of cables wound upon it. It also provides for insulated channels for each cable through the agency of the insulating cheek members 108, 108. Of course, one large barrelled drum has been designed also by the applicant for a three-phase, three conductor cable, but there are certain important advantages in the use of three separate power cables, and one independ-

ent mechanical cable for strain purposes. For example, there would less strain on the insulation of three comparatively small cables, than upon the insulation of one comparatively large cable.

The cable drum is provided with one or a pair of similar large gears 109 and 110 positioned and attached to engage the small similar pinions 111 and 112 of the reversable electric motor 113, supported by the casting 104. Proper electric wiring, switches and starting gear are naturally understood to be present but not illustrated in the interest of simplicity.

The housing 114 for the three slip-rings and brush gear 115 for the connection of the conducting cables to the "electric fish" is made independent of the revolution of the drum through the slip-rings and brush gear at 116 which represents the flexible cable 108 of the previous view.

The double-armed yoke member 117, being firmly attached to the hollow shaft 68 remains stationary when the casting 104 turns to the right or left when so led by the tension of the cables running to the electric fish, but the distance through which it may move together with its rate is regulated by the piston rods pivoted at 120 and 121 to the arms of the double yoke member 117. These pivoted piston rods play in and out of the cylinders 122, 123, pivoted at 124 and 125, respectively. The piston heads 126 have one or more minute passages bored through them (passages not shown) to allow the restricted passage of a non-freezing fluid 126' to pass through them. These control cylinders and enclosed pistons and fluids prevent the rapid movement of the drum carriages, as for instance in the roll of a ship in case the cable drums and more or less cable wound upon them, were not precisely balanced by the counterweights 70'. In other words, only a prolonged pull of the cables from the "electric fish," from right to left or from left to right, respectively, would cause the drum carriage to alter its position, and thereby the position of the tongue member 130 and its spade-shaped end member 131 which is positioned between the duplicate sets of electrical contact making spring members 132, 133, which spring members may be advanced or retracted through the agency of the insulated gear with screw threads and hand wheels 134 and 135. Thus it will be appreciated that a steady and prolonged pull of the "electric fish" to the right or left, and only a steady and prolonged pull, will cause the spade-shaped head member 131 to close with the right or left contact making spring members. It is through these right and left contact making spring members, that the oscillator transmitters for the wired radio carrier currents, to the filtered relay, amplifiers and switch gear of the reversable electric steering motor in the electric fish, are started and stopped. It is not deemed necessary or desirable to illustrate the complicated connection here, in the interest of simplicity; suffice it to say that the comparatively high frequency carrier currents are led into and out of the power cables of comparatively low frequency through condensers indicated schematically at 138 and 139.

By means of the hand wheels 134 and 135, it now becomes evident that the closeness of the control of the electric fish in their steerage way in the sea may be effected, and when necessary or desirable may be manually controlled, by simple auxiliary circuit closures and openers (not shown in the drawings).

With further reference to Figures 8 and 9.

Here the ship 65 again shown in plan view is equipped with somewhat simpler and narrower, counter-balanced winding drums, for the reception of a single conductor electric cable, insulated for direct current at 2500 volts, for example, the drums being shown in a reversed direction of pay-out over those shown in Figures 4 and 5.

The present equipment may, or not, comprise a torpedo arresting or torpedo destroying belt 72 and 73 with its cables electrically charged for magnetic torpedo warhead or magnetic mine destruction, and with or without the rear or trailing loop shown specifically in Figure 9.

The present equipment may in an alternate case comprise the aforesaid loops and its depth controlling auxiliary shown in Figures 4 and 5 and instead of the belts 72 and 73 shown in the dotted lines, merely one or more of the cable elements of the belts may be employed for the purpose of establishing magnetic fields in the sea for the operation of magnetic mines (indicated at 77) and the like, especially the magnetic warheads of this later design of fish torpedo. In the case the belt is used, however, one or both of the mechanical cables in the belt construction, later illustrated and described, may be insulated electrically and be so interconnected in circuits as to act as combination power cables for the electric fish and magnetic mine and magnetic warhead torpedo destroyers—particularly the latter, since the equipment may be sent down, by remote control, or otherwise to not only depths just below the troughs of waves in the sea, but far below them to depths greater than the drafts of the deepest ships hulls.

In the present view a steam turbine electric generating set is shown at 140, the electric generator being of direct current design, and possibly of the three wire type for grounded neutral. This generator may produce direct current with proper commutator design, of 2500 volts, for example, and be connected in series with all four of the electric motors in both of the electric fish as shown.

There is no difficulty in generating and commutating direct current at 2500 volts, a system exemplified by the practice once, if not now, in vogue with certain Swiss railroads, for example. The current in this instance will be for the four 300 horsepower motors as indicated diagrammatically in the location of the two towing fish at 25, 25, of the order of 260 amperes, and the copper conductor of the cable may consist of twenty strands or more of copper wire aggregating in circular mills that of a No. 0 wire A. W. G., or preferably such a stranded conductor comprising copper-weld construction for high tensile strength, a subject already dealt with in this specification.

It is of course understood (although not shown) that suitable switchgear is installed for the electric generator set 140. When this is an alternating current equipment we would require the proper generator panels, direct current exciter panels, bus tie, in case two sets of generators are used, and a synchronizing panel.

To secure variation in the towing power of the electric fish we must of course have means for varying the speed of the electric motors, and it is provided to secure a range of 50–100 per cent speed. This can readily be accomplished by means of engine governor control through electrical connections to the leads 102 and 103 of the

counterbalanced winding drums, illustrated and described in Figures 6 and 7.

In order to maintain an alternating current generator voltage proportional to the speed, it will be necessary of course to provide ways and means of holding its exciter voltage constant over the speed range. This applicant can do this by furnishing an exciter capable of maintaining rated voltage over the 2 to 1 speed range and then use a voltage regulator, operating in the field of the exciter to hold constant exciter armature voltage. A "diactor" type of voltage regulator will serve this purpose. When the electric generator **140** is of the direct current type, the question of variation in the towing power of the electric fish is even simpler to handle through the agency of the aforesaid circuit to the counter-balanced winding drums and voltage regulators.

The distance out of the cables **71**, **71'** and/or the belts **72** and **73**, or these cables as such, may also be governed by the angle controlling drum gears, as before described only in the reverse order of pay out as now illustrated.

A rear loop may be dragged astern of the ship **65** for the protection of a vessel following in the wake against one or more magnetic mines.

There is not room enough on the drafting sheet to illustrate such a loop, in Figure 8, but it is clear that one may be towed as an extension of the conductors of the belt **72**, **73**. With a loop towed astern, the center of the loop may have a depth controlling device **77'** such as that provided for the leading loop **75**. Moreover, it may have an independent towing cable **75''** attached to a ring at the stern of the ship, to prevent the loop from becoming too narrow in form to be effective. In the case a loop is towed aft, the ship towing it relies upon her degaussing system to protect her from magnetic mines. The useful object of the loop towed astern, is to trip the mechanism in a magnetic mine and explode the same before a ship following may be blown up. Applicant may tow one or more loops (**75'** and **75''**) astern, with distances between them, to give one or more magnetic disturbances to a magnetic mine, since some types of magnetic mines require one or more magnetic disturbances to set them off.

The rear loop may be in series with the entire system or be in an independent circuit. When the leading loop **75** is not used, and a rear trailing loop behind the ship is used, a return conductor from the "electric fish" **25** is of course installed. All of the wiring and connections are so simple and so readily understood by electrical engineers, that detailed diagrams are not given here.

The distance out of this belt device **72**, may also be controlled by some alternate design of radiant energy control **145**, **145'** using an approved radiant energy projecting and responsive system, respectively, with suitable chronograph time factor measurement and control system.

Sound, light, heat, electro-magnetic waves, and the like may be employed here on the range-finding and deep sea sounding principles, for example. Such a system could be devised to act as an alternate plan of control for the wired, or guided radio remote control of the responsive steering devices in the "electric fish."

The diagrammatic representation of the "electric fish" **25**, **25** in these views includes the diagrammatic representation also of the wired radio steering gear, showing the motors **35**, **35**, the storage batteries **35'**, **35'**, the rudders and gear, **32**, **32**, and the condensers, grounds and other necessary devices at **35''**, **35''**.

With the present direct current equipment, it is possible through the agency of an oil immersed pole changing switch (not shown) at the generating set **140**, to reverse the current flow through the entire circuit at will, without of course reversing the direction of rotation of the motors **26** and **27**, because it reverses both in the fields and armatures. Since this is an important feature in operation for magnetic mine destruction, applicant deems it pertinent to explain that to reverse an electric motor of the direct current type, the current supplying it must be reversed in either the field or armature, but not in both. Since we are by the nature of the electrical connections reversing the current in both when we interpose the pole changing switch, we do not reverse the motors, and consequently the propellers or the direction of motion of the "fish" **25**.

By reversing the current in the entire system at intervals, however, we reverse the magnetic polarity at the magnetic fields in the sea, and this may serve as a valuable feature in exploding magnetic mines. Some magnetic mines may be fashioned to require such changes in polarity, or they may be fashioned to require a plurality of "tripping" forces in order to explode them. In other words, this ability to change the polarity of the magnetic fields in the sea, adds to the flexibility and possible broader uses of the system in designs of magnetic mines yet to be dealt with.

With the loop **75** as a leading series loop with its float or depth controlling device **77'**, its destruction by a mine need not stop the "electric fish" for the salt water of the sea could well act as a return path for the current, especially if the large metallic shell of the "fish" **25** has been made one electrode.

With further reference to Figure 9. Here is shown in simple diagram one of applicant's alternate plans for exploding magnetic mines for the protection of a ship following in the wake of the vessel carrying the equipment. The loop floats **77'** may be fashioned for the opening of the loop by the crew of a service launch and moreover at this junction be provided with a coil for increasing the ampere turns, and consequently the magnetic field at this zone.

With further reference to Figures 10 and 11. Here is illustrated a foreshortened view of a section of one design of my fabricated, vertically floating, barely buoyant, and consequently easily totally submerged, submarine low "skin friction" torpedo-arresting, or torpedo destroying belt devices. The belt device is shown with a portion of the canvas removed in order to illustrate better the woven net. In these particular views the belt device is for torpedo arresting, because of the yieldable hempen net used between the double canvas sheathings, but in an alternate design, a hard strong plane surface may be interposed between the canvas sheathings to detonate and destroy a torpedo upon impact. Here are shown factory fabricated wooden float pieces which are mill machined, impregnated with water proof compound and well painted to prevent the absorption of water and consequent change in buoyancy, which would impair or destroy the usefulness of the float. Two complementally formed pieces **150** and **151** of the fabricated and treated float members are clamped together by large wood screws **151'**, **151'**, embracing a stranded steel cable **152**, positioned loosely in the cylin-

drical passageway 153 formed by joining the opposite float pieces, both float pieces being suitably grooved. This cable is here illustrated bare for tensile purpose, but as previously stated for magnetic field purposes, it may be insulated to serve both tensile and electrical conductor purposes. 154 is a canvas sheathing, comprising one or more coats of marine "metallic paint" applied upon both sides and "simonized" by treating with paraffin, since paraffin has been found by researches in towing plane surfaces in water to offer a minimum of "skin friction."

Back of this treated canvas is the stout woven net 155, comprising the horizontal warp members 156, and the vertical woof members 157, the latter of which run up into the well fabricated grooved clamping space, together with an edge of the canvas 154. 154' is a similar sheathing disposed on the other side of said net. The lower edge of this fabricated belt is clamped between two complementally formed metal sinker members 158 and 158', providing a cylindrical passageway 159 therebetween loosely receiving therein the steel cable 161. The metal sinker members are riveted together by the rivets 160, 160. This steel cable 161 may or may not be electrically insulated to serve as an electrical conductor as well as a mechanical strain member, as in the case of its companion cable 152.

Both of the cables, 152 and 161, respectively, may be copper clad, or be of stainless steel, or be of a combination of these two ways and means to prevent or retard rusting in the salt water of the sea.

The vertical woofs 157 at this lower edge of the belt device, are likewise securely clamped by the metal sinker members 158, as are the canvas sheathings 154 and 154' by the metal sinker members 158.

With further reference to Figure 11.

Here we have a transverse sectional view of Figure 10 showing clearly the two painted and paraffined canvas sheathings 154, 154' necessary to completely enclose and to prevent the passage of sea water through the network comprising the horizontal warps 156 and the vertical woofs 157 of the net work, as well as the pair of screwed together wooden float members 150 and 151.

Here we see how the metal sinker members 158 and 158' likewise clamp the sheathings and the warp and woof of the net work. At the lower edge of this sinker member, in addition to the rivets 160, 160, the metal sinker members 158 and 158' are securely united by the U bend 162 of the member 158' embracing an edge of the said member securely.

An inspection of this fabricated construction will make clear the easy and quick assembly of the component parts.

An inspection will also make it clear that applicant may add any number of canvas sheathings, or include between them a net work of stouter ropes, to meet any requirement of impact without increasing the "skin friction" of this design of belt device.

Also it will be appreciated that a steel net may replace the rope net, provided of course the size of the impregnated and painted wooden floats are enlarged to care for the added weight of the steel over the hemp rope which latter has substantially negligible weight in sea water.

It will also be apparent that a metal plate may be substituted for the net work, and be thick and strong enough to cause the destruction of the torpedo by causing the detonation of the explosive charge in its warhead. Some torpedoes may be fired by the driving in of a contact pin in the war-head, while others must strike a sufficiently resistant surface so as to cause a sufficiently rapid decelerated rate of motion, to cause an inertia device in the warhead to move swiftly and smartly enough to explode the detonator.

With such a hard surfaced and strong plane surface between the canvas sheathings, applicant's belt device consists of a torpedo destroying equipment.

With further reference to Figure 12.

In this last illustration we have a short length of the same side view of the belt device, adjacent to the lower or sinker member, as in Figure 10.

Attached to the metal sinker member 158, by means of the rivets 165, 165, is the important cigar shaped automatic depth controlling device 170, with conical or stream line ends, fashioned of sheet metal and adapted to not only automatically set and maintain a sub-surface depth when its belt device is towed at a set speed, but adapted to be controllable for one or more sub-surface depths by remote control from the ship. Therefore it will now be appreciated that both the electric towing fish and the ship protecting belt devices, are automatically controlled as to depth of sub-surface travel, and also remotely controllable and adapted for one or more sub-surface depths by remote control from the ship. This gives the entire equipment great flexibility of use, as will be appreciated by those familiar with the problems involved in combating great seas at times, and in combating deeply planted magnetic mines and deeply launched magnetic warhead torpedoes.

In this cigar shaped device we have the bulkhead member 171, the compression spring 172 exerting a balancing pressure against the compression spring 173, through the medium of the rigid slidable rack device 174, with its teeth 175 engaging the teeth 176 on the enclosed gear wheel 177 keyed on the shaft 178, which passes through stuffing box bearings (not shown) in the shell of the cigar shaped device 170, which is fashioned to be operative as a depth controlling device when it travels from right to left in the direction of the large arrow above it on the sinker member 158. The shaft 178 carries exteriorly in the sea a pair of aquaplanes, one on each side of the device, the port aquaplane 179 being shown by dotted lines, said aquaplane for hydrostatic reasons being pivoted at its central zone. As previously pointed out this central pivoting requires the minimum of turning or angle changing, as well as angle holding power.

An opening 180 into the casing of the device allows the water of the sea to enter the open end of the metal bellows 181, the opposite end of the bellows being closed to receive the combined thrust of the spring 172 and the pressure of the water of the sea when the device navigates below the surface of the sea. The pressure of the sea water is indicated here by the two long arrows.

At the right or stern end of this cigar shaped device 170 is the brass or non-magnetic member 182 centrally bored through and reamed to slidably receive the head member 183 for the spring thrust, and an end of the steel rod 174' which is adjustable in longitudinal travel by the screw device 175'.

The solenoid 186, when sufficiently energized by an electric current through its leads 184, 185 of

its insulated winding 186', is capable of advancing the steel rod member 174' and thereby in increasing the tension of the spring 173. This combination of steel rod member 174', the solenoid 186 and the spring 173 is in effect a rugged amperemeter, and is capable therefore, through the toothed rack 174 and the toothed wheel 177 to turn the aquaplane 179 against the pressure of the spring 172 and the pressure of the water of the sea in the metal bellows 181, which may be made of brass or stainless steel, in a controllable quantitative manner through the agency of a storage battery and rheostat on the ship. Now as the depth of travel of the device increases in the water of the sea, the pressure of the water in the interior of the metal bellows correspondingly increases, and concurrently the pressure in opposition to that of the remotely controlled tension of the spring 173 also increases, and therefore it becomes apparent that applicant has an automatic depth control device for his protective belt and in addition one for remote variable depth control.

It is obvious that those skilled in the various arts and sciences involved as herein set forth, may vary the details of construction and arrangement of parts, as well as the methods, ways and means of the applicant which enable him to produce the foregoing new and useful equipment for the protection of ships, without departing from the spirit of this invention, and therefore it is not desired to be limited to the precise foregoing disclosures, except as may be required by the claims.

Having described my invention, I claim:

1. In combination a submarine tow boat comprising a depth controlling device, a motor for activating a propeller on said tow boat, and means operable from a remote point for energizing said motor and for controlling the movement of said tow boat; and a protective device fashioned to guard the hull of a ship from sea-submerged explosive contrivances, said protective device having a flexible connection with said tow boat whereby to be towed at a considerable distance therebehind, said device provided with hydraulically and electrically actuated means for controlling the depth of said device in the water of the sea.

2. In combination a submarine tow boat comprising a depth controlling device, a motor for activating a propeller on said tow boat, and means operable from a remote point for energizing said motor and for controlling the movement of said tow boat; a protective device fashioned to guard the hull of a ship from sea-submerged explosive contrivances, said protective device fashioned to be towed by said submarine tow boat; and remote control means for varying the depth of navigation of said tow boat and said protective device, said means comprising a spring-tensioned aquaplane responsive to hydraulically and electrically initiated pressures.

3. In combination a submarine tow boat comprising a depth controlling device, an electric motor for activating a propeller on said tow boat, and a remote controlled rudder on said tow boat; a protective device fashioned to guard the hull of a ship from a submarine explosive contrivance, said device adapted to be towed by said tow boat; an electric cable connected to said motor and leading to a source of electric power on such ship; and cable receiving means disposed at the side of such ship, said means controlling the angle of lead of the remote controlled rudder of said tow boat in accordance with the angle made by said cable with the side of such ship.

4. In combination a submarine tow boat comprising an electric motor and a propeller connected thereto, a rudder at the bow fashioned to be operated by electric remote control, and a pressure responsive depth regulator for the tow boat, said regulator subject to variation through electric control; and a cable for supplying electric currents for energizing said motor, for operating said rudder, and for variably controlling said regulator, said cable leading to a source of electric currents remote from said tow boat.

5. Apparatus for protecting the hull of a ship from submerged mines and torpedoes, comprising a protective screen for said hull, a tow boat for towing said screen in spaced relation to said hull, and means for variably controlling such spaced relation as well as the direction and depth of navigation of said tow boat and said screen, said means comprising an electric cable connecting said tow boat with a source of electric power on such ship.

6. In combination, a submarine tow boat comprising a depth controlling device, an electric motor for actuating a propeller on said tow boat, and a remote electric current controlled steering device for said tow boat; an electric cable extending from said tow boat to a source of electric power, one end of said cable fashioned to supply such power to said motor and to said steering device; and a yieldably mounted member receiving the other end of said cable and fashioned to connect it with the source of electric power, the yieldable mounting of said member comprising control means for the current from such power source to said tow boat.

7. In combination, a submarine tow boat comprising an electric motor for actuating a propeller on said tow boat, and a remote electric current controlled steering device for said tow boat; an electric cable extending from said tow boat to a source of electric power, one end of said cable fashioned to supply such power to said motor and to said steering device; and a current controlling motor operated winding drum receiving the other end of said cable and fashioned to connect it with the source of electric power, and said drum responsive to the tension exerted by said cable and thereby controlling the current to said tow boat.

8. A motor operated winding drum for an electric power cable and adapted to pay out and to wind in said cable at will, said drum comprising an axle and a counterbalanced pivoted support therefor, said axle comprising slip-rings and brush gear for an end of said cable, said support comprising a cylinder, a piston and a fluid in said cylinder for retarding the movement of said support but fashioned to allow said winding drum to turn and assume a position in line with the direction of pull of said cable with respect to said drum.

9. A motor operated winding drum mechanism for an electric cable, comprising a drum, an axle and an electric motor therefor, a slidable bearing for said axle, a pivoted support for said bearing, a spring retarding the slide of said bearing, and a counterbalance for said winding drum.

10. A cable winding drum mechanism for a ship, comprising a stanchion secured to the side of the ship, a pedestal mounted on the stanchion, a revolvable bearing in the pedestal, a substantially counterbalanced carriage mounted on said bear-

ing, and a motor operated cable winding drum mounted on said carriage.

11. Apparatus for protecting the hull of a ship from submerged mines and torpedoes, comprising a tow boat having electrically controllable propellent and navigation direction means, a protective screen attached to said tow boat for towing thereby in laterally spaced relation to such ship, a source of electric power on such ship, an electric cable extending from said tow boat directly to such ship for supplying electric currents from said source of power to said means, and a winding drum mechanism for said cable mounted on such ship, said mechanism automatically controlling the angle of lead of said tow boat.

12. Apparatus for protecting the hull of a ship from submerged mines and torpedoes, comprising a tow boat having electrically controllable propellent and navigation direction means, a protective screen attached to said tow boat for towing thereby in laterally spaced relation to such ship, a source of electric power on such ship, and a winding drum mechanism for said cable mounted at the side of such ship and controlling the angle of lead of said tow boat in accordance with the angle made by said cable with the side of the ship.

13. In combination a submarine tow boat comprising a depth controlling device, a motor for actuating a propeller on said tow boat, and means operable from a remote point for energizing said motor and for controlling the movement of said tow boat; a protective device for the side of a ship, said device secured solely to and towed by said tow boat in spaced disconnected relation to such ship; an electric cable connecting said tow boat and the ship for supplying currents to energize said means; and radiant energy means for measuring the distance of said protective device from the side of the ship, and to substantially automatically maintain such measured distance.

14. An electric cable winding drum mechanism for a ship, comprising a pedestal secured to said ship, a shaft mounted vertically in said pedestal, a carriage mounted on said shaft and extending horizontally in opposite directions therefrom, a cable winding drum slidably mounted in one end portion of said carriage and under spring tension to be responsive to the pull of the cable, a counterbalance for said drum mounted on the opposite end of said carriage, and means for supplying electric currents to the cable wound on said drum.

15. In combination a submarine tow boat comprising a depth controlling device, an electric motor for activating a propeller on said tow boat, and a remote controlled rudder on said tow boat; a protective device fashioned to guard the hull of a ship from a submarine explosive contrivance, said device adapted to be towed by said tow boat; an electric cable connected to said motor and leading to a source of electric power on such ship; and radiant energy means for maintaining spaced relationship between such ship and said protective device.

16. In combination a submarine tow boat comprising a depth controlling device, an electric motor for activating a propeller on said tow boat, and a remote controlled rudder on said tow boat; a protective device fashioned to guard the hull of a ship from a submarine explosive contrivance, said device adapted to be towed by said tow boat; an electric cable connected to said motor and leading to a source of electric power on such ship; and phonic means for maintaining spaced relationship between such ship and said protective device.

17. In combination a submarine tow boat comprising a depth controlling device, an electric motor for activating a propeller on said tow boat, and a remote controlled rudder on said tow boat; a protective device fashioned to guard the hull of a ship from a submarine explosive contrivance, said device adapted to be towed by said tow boat; an electric cable connected to said motor and leading to a source of electric power on such ship; and electromagnetic means for maintaining spaced relationship between such ship and said protective device.

18. In combination a submarine tow boat comprising a depth controlling device, an electric motor for activating a propeller on said tow boat, and a remote controlled rudder on said tow boat; a protective device fashioned to guard the hull of a ship from a submarine explosive contrivance, said device adapted to be towed by said tow boat; an electric cable connected to said motor and leading to a source of electric power on such ship; and vibratory means for maintaining spaced relationship between such ship and said protective device.

19. In combination a submarine tow boat comprising a depth controlling device, an electric motor for activating a propeller on said tow boat, and a remote controlled rudder on said tow boat; a protective device fashioned to guard the hull of a ship from a submarine explosive contrivance, said device adapted to be towed by said tow boat; an electric cable connected to said motor and leading to a source of electric power on such ship; and variable distance remote control means for maintaining spaced relationship between such ship and said protective device.

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