

Jan. 18, 1944.

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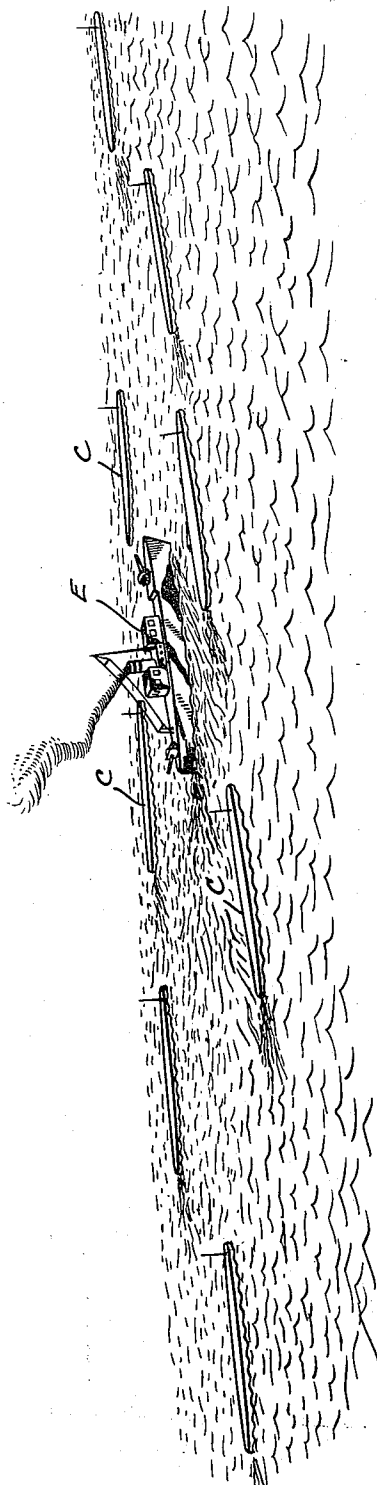
2,339,257

SYSTEM OF TRANSPORTATION

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3 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

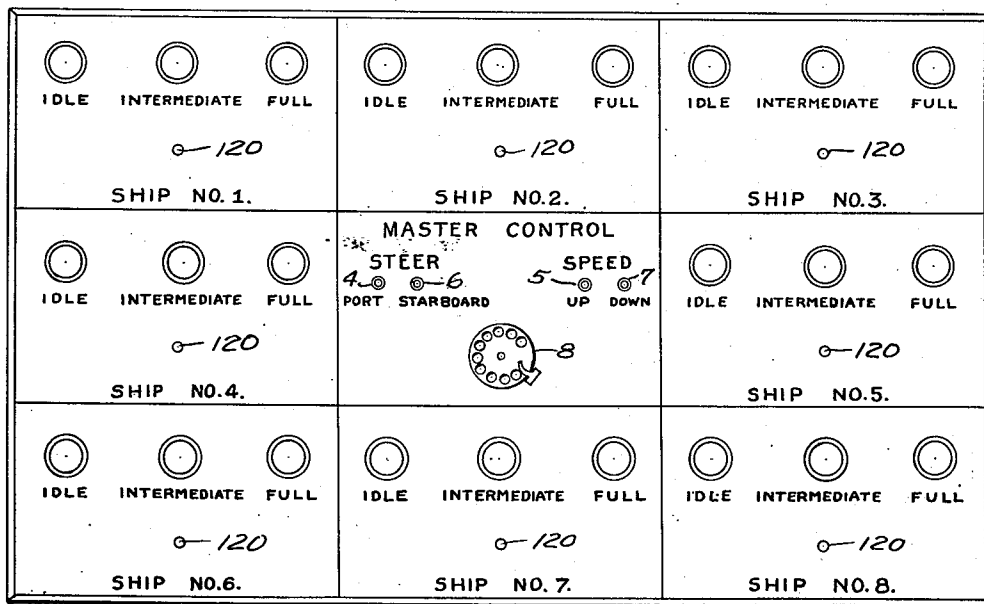
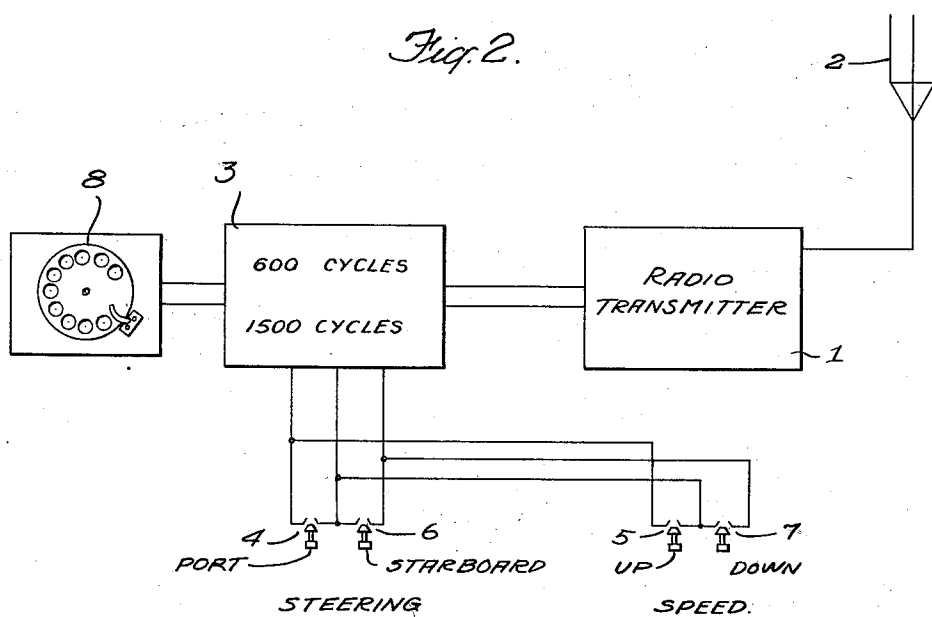


Fig. 3.

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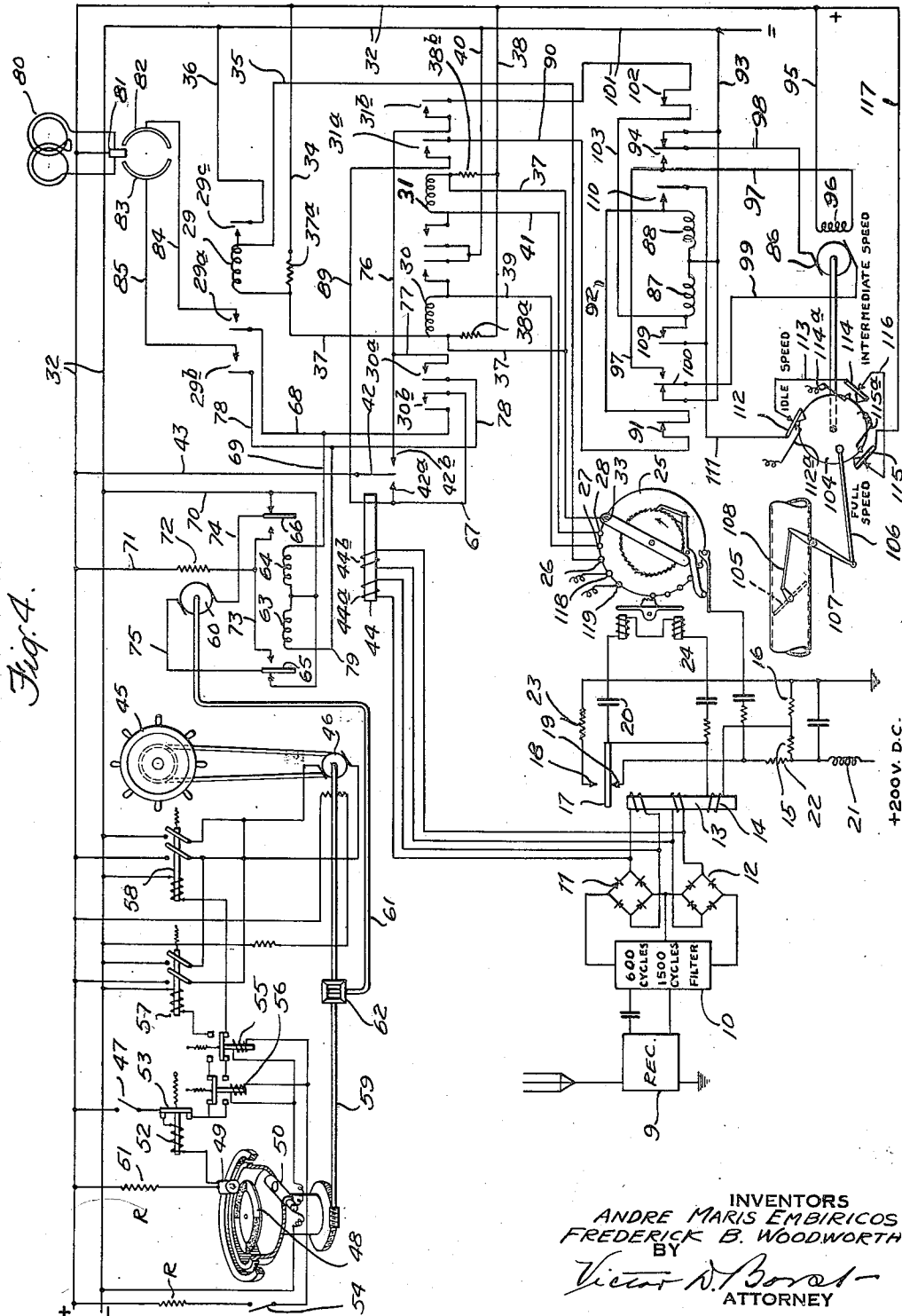
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3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

2,339,257

SYSTEM OF TRANSPORTATION

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Application September 1, 1942, Serial No. 456,902

20 Claims. (Cl. 114—0.5)

The primary purpose of the invention herein disclosed is to improve the safety and economy of transportation of cargoes by water. It will be appreciated that this is particularly important in time of war when the loss from torpedoes and mines becomes a significant factor.

Generally speaking there has been no change in the design and construction of cargo carrying vessels used in war from those used in peace. The superstructure and smoke-stacks of the carrier units make them visible to enemy craft at considerable distance and the individual units are sufficiently large to justify the expenditure of a torpedo to sink them. The difficulty of replacement of such vessels as fast as they are sunk presents a very real problem, as is well known. The formation of convoys in the interest of common safety involves delay and necessarily slows down the speed to that of the slowest unit in the convoy.

The invention herein contemplates decided change in the design and character of cargo carriers and in the manner of handling group or convoy systems. For example in the case of ocean going tankers, instead of units of, say, 10,000 tons dead weight, it is proposed to construct smaller, barge-like units of, say, 2000 tons dead weight. The boats will be of special design without superstructure and with the center of gravity as low as possible so that under load the deck will be practically flush with the surface. Diesel engines will be used so that no smoke-stacks will be required and only the air intake of the engines and the ventilation of the holds will be above the water at all times.

Since the boats run practically submerged it is not contemplated that there shall be any permanent crews aboard. Provision is therefore made in accordance with the invention to direct and control the boats from an accompanying or escort boat such as a corvette or destroyer or submarine. These cargo boats may be so proportioned that five of them are equivalent in capacity to one conventional tanker, and it is feasible for one escort ship to convoy ten or even more of these cargo boats of special design, arranged for example as a screen, half on one side and half on the other of the escort ship.

It is apparent that such cargo boats may be rapidly and cheaply constructed. They may be built from reinforced concrete and, as an example, they may be 260 feet long and 36 feet beam and a depth of 27 feet, but of large cargo dead weight capacity for such measurements. A series of ten to fifteen water-tight compartments

will be incorporated in the design so as to make it comparatively invulnerable to torpedo attack. The construction of carriers in these small and inexpensive units vastly increases the difficulty on the part of the enemy in effectively raiding a convoy and the damage that can be done by a single torpedo is proportionately reduced. Furthermore such a convoy presents little visibility to the enemy, the limit probably in no case exceeding two miles.

According to the invention the direction or control of the cargo boats will be entirely automatic in the form of remote radio control from the escort ship. While in its broad aspects the invention is not limited to any particular form of radio control, the invention has been successfully embodied and operated and will be illustrated in the form of a radio control system in which the local control circuits on the cargo boats are selectively picked out for operation by a selector circuit similar to that used for calling in radio telephony. Impulses of audio or above audio-frequency modulation from a two-tone oscillator are transmitted over the radio channel, the sequence of impulses being controlled by a mechanism such as a telephone dial, and the selector set on each cargo boat is connected to the audio output circuit of a radio receiver and responds selectively according to the code dialed to set up a desired circuit. In this way motors can be selectively energized to perform any one of many local functions, such as steering, throttle control, the operation of automatic bilges or automatic alarm systems. The energization of the motors will suitably be directionally controlled through a system of relays that will be selectively operated by a master control relay that responds differently to the two modulation impulses of different frequencies. Preferably the radio transmitter will generate an ultra short wave capable of either amplitude or frequency modulation so that the signal will not be detected and the presence of the boats revealed to an enemy beyond a radius of approximately 25 to 30 miles. The code signals are subject to ready change and will be frequently changed, for example at the end of each trip, so as to avoid the likelihood of the boats getting under unfriendly control by one who happened to have devices for receiving the special waves.

The boats will be equipped with automatic steering mechanism for keeping the boats on a set course, and this will be controlled either by a suitable meridian seeking compass, such as a magnetic compass or by a radio compass or by

both. The remote radio control means will allow the operator to enable or disable the radio compass at will. The radio loop will seek a null position with respect to the wave front of a signal from the transmitter, and relative motion between the boat and loop makes a contact and energizes a motor that operates the rudder, and thus keeps the boat on the set course. The course is set with relation to the direction of the signal source as represented by the loop position and is determined by the relative setting of the contacts.

It is contemplated that the escort ship will have in its control room a panel for each escorted boat and a master control panel containing the code dial and the necessary control buttons to effect the desired operations and to determine the direction or degree of control. The individual control panels will upon call to the respective boats indicate the condition sought, for example, the throttle position and hence the speed. Means may also be provided to signal back to the escort ship upon demand and to indicate on the panel the relative course of the boat. There may also be an emergency switch which in case of attack may be employed to set in motion steering control members to turn the boats variously from their established courses and cause them to scatter. When the danger is over it will be a simple matter to relocate the boats and restore them to an orderly course. Meanwhile the armed escort boat will be free to cope with the attacking enemy boat.

Other features of the invention will appear from the following particular description of the embodiment shown in the drawings and chosen for the purpose of illustration. This embodiment will not contain means for performing all the functions above referred to but it is thought that the system as shown will be sufficiently representative to present the invention which will be hereinafter pointed out in claims.

Fig. 1 is a perspective representation of a flotilla embodying the system of this invention.

Fig. 2 is a diagram of the transmitting apparatus on the escort ship.

Fig. 3 is a diagram of a panel arrangement suitable for the boats shown in Fig. 1.

Fig. 4 is a schematic and wiring diagram of that portion of the system on an escorted boat.

The escorted flotilla as shown in Fig. 1 is proceeding on a normal course in regular order, the eight cargo boats C being presumed to be under the control of the escort ship E, shown as a corvette, through remote radio control as shown in the succeeding figures. The corvette is screened by the boats on either side, three on one side and three on the other, with two boats in line with the corvette, one in front and one astern. The distance between the boats will be a matter of choice but in ordinary seas would ordinarily be not less than a half mile in lateral spacing. As shown, the decks of the cargo boats are practically awash and therefore will not be visible at any considerable distance.

On the corvette is a radio transmission apparatus as shown in Fig. 2. The radio transmitter 1 is of a type to transmit from the antenna 2 ultra high frequency waves which will have a limited radius. An oscillator 3 is known as a two-tone oscillator in that it produces impulses of two frequencies, depending upon which of two oscillator circuits is closed. The frequencies for example are indicated as 600 cycles and 1500 cycles, respectively. Two buttons are connected in par-

allel into each circuit. For example button 4 and button 5 will both energize the oscillator for impulses of 600 cycles, and button 6 and button 7 will both energize the oscillator for impulses of 1500 cycles. With the transmitter operating these impulses go over the radio channel as modulation impulses. The dial 8, as in a telephone ringer with a selector set, sends out the two impulses sequentially repeated as many times as the dial number indicates. For example if the number 4 is dialed, the two impulses will be repeated four times.

The radio receiving and selecting apparatus are shown diagrammatically in Fig. 4. The selector set is connected to the audio output circuit of the receiver 9, and it consists of a filter 10 that separates the two impulses, a rectifier 11 for the current from the 600 cycle impulses, a rectifier 12 for the current from the 1500 cycle impulses, and a biased and polarized relay 13 oppositely pulsed by the two rectified currents. The biasing winding 14 of relay 13 is energized from the 200 volt supply through a voltage divider consisting of resistances 15 and 16. The relay 13 controls the relation of movable contact 17 with fixed contacts 18 and 19. Current from rectifier 11 urges contact 17 in one direction and current from rectifier 12 urges it in the opposite direction. The bias winding holds contact 17 in the last position to which it is moved, until the opposing winding is energized and it is forced against the other contact.

Condenser 20 is alternately charged and discharged by the transfer contacts 18 and 19 of relay 13 when the relay is pulsed by operation of the dial 8. The charging current flows from the 200 volt supply through a radio-frequency choke coil 21, resistance 22 and contact 19 of relay 13. The discharging current flows through contact 18 and resistance 23 to ground. This pulses relay 24 of the selector to operate the selector code wheel 25 in the well known manner, this being the Western Electric Company No. 60 BR selector and the construction and operation of the code wheel being shown in Patents Nos. 1,200,095 and 1,343,256.

The code wheel 25 carries a contact which will make contact with any one of a plurality of local, fixed contacts depending upon the code number that is dialed. As shown there are three active contacts 26, 27 and 28 that govern, respectively, relay solenoids 29, 30 and 31 each of which controls two operating contacts and one holding contact. Solenoid 29 when energized closes two normally open contacts 29a and 29b, and also the holding contact 29c the movable element of which is connected to the negative side of power line 32, the fixed element being connected with one side of solenoid 29 and the other side of the solenoid being connected in parallel with the positive side of the power line and with cut-out contact 33 also engageable by the contact arm of wheel 25. Therefore when the code wheel is on contact 26 solenoid 29 is energized from lead 34, solenoid 29, lead 35, contact 26 to ground. At the same time contact 29c is made and the holding circuit comprising lead 34, solenoid 29, contact 29c and lead 36 is made. The code wheel may now leave contact 26 and solenoid 29 will remain energized until contact 33 is dialed whereupon solenoid 29 is shunted through leads 34 and 37, a resistance 37a being provided to prevent a dead short circuit.

The energizing, holding and shunting circuits of relay solenoids 30 and 31 may be similarly

traced in connection with their respective code contacts 27 and 28. When the code wheel contact arm engages contact 27 current flows from the positive side of supply 32 through lead 38, resistance 38a, solenoid 30 and lead 39 to contact 27 and thence to ground through the code wheel. Holding contact 30c is thus closed completing an alternative circuit through lead 40. Relay contacts 30a and 30b are thereupon closed. When code contact 28 is engaged by the code wheel contact solenoid 31 is energized through lead 38, resistance 38b, solenoid 31 and lead 41 to contact 28 and thence to ground. Holding contact 31c is thus made closing an alternative circuit through lead 40. Also relay contacts 31a and 31b are closed. Lead 37 for contact 33 connects with lead 38 at points to shunt the solenoids 30 and 31.

Relays 29 and 30 control a course changing motor and relay 31 controls a throttle operating motor, as will be described. Relay 29 functions with an automatic radio compass or direction finder which is self sufficient to determine the direction of change of course, but a reversing switch coacts with the contacts of relays 30 and 31 to determine in one instance the direction of change of course and in the other instance the direction of throttle control.

This reversing switch consists of reversing contact element 42 connected by lead 43 to the positive side of the line, and fixed contact elements 42a and 42b. Contact element 42 is the pivoted armature of polarized relay 44 that is wired in parallel with the polarizing windings of relay 13. Winding 44a is energized by the rectifier current from the 600 cycle frequency impulses, and the reverse winding 44b is energized from the 1500 cycle impulses. Therefore when the oscillator 3 is caused to emit 600 cycle frequency impulses armature 42 will close the reversing switch contacts in one direction, and when 1500 cycle impulses are transmitted over the radio channel, the reversing switch will be oppositely closed. The armature 42 is spring biased toward the center or open circuit position, so that when neither polarizing winding is energized the contacts are open.

Having been set upon a definite course the cargo boats are equipped with automatic means to hold them upon that course. This automatic steering means shown schematically in Fig. 4 is of the type shown in Patents Nos. 1,885,098, 2,112,490, 2,112,504 and 2,116,629. A photo-electric cell and a source of light therefor cooperate with a specially designed compass card of a magnetic compass to selectively activate the circuit of the reversible steering motor.

This automatic pilot arrangement will briefly be described. The rudder (not shown) is selectively operated by hand through steering wheel 45 or by power through steering motor 46, depending upon the condition of a clutch (not shown) which incidentally controls switch 47, the switch being open when the steering wheel clutch is engaged and closed when the clutch is disengaged.

The compass card 48 is gimbal mounted in the usual way and is constructed so that by its relative position it determines the amount of light from a lamp 49 that falls upon a photo-electric cell 50. For example, the periphery of the card may be cut out quadrantly, as shown, so as to provide radial edges 90° apart which, for example, will be in radial alinement with the cardinal points of the compass. The lamp

and cell are carried by the compass head which is maintained in zero position by the motor 46. This motor is energized in one direction when full light is falling upon the cell, in the opposite direction when no light falls upon the cell, and is deenergized when the light intensity is intermediate, that is, when the light is half intercepted by the card.

When the operator disengages the clutch connection between the steering wheel and rudder stock and thereby locks the steering wheel, that act closes switch 47. This connects lamp 49 across the line through resistance 51. At the same time it energizes armature 52 and closes the contacts of switch 53 which controls the circuit of motor 46. Switch 54 is then closed which connects the photo-electric cell across the line in parallel series with the solenoids 55 and 56 the plungers of which carry switches that coact with front and back contacts, as shown. Solenoid 55 responds to low intensity current and solenoid 56 to relatively high intensity current. That is, switch 55 is attracted when the light is half cut off and both are attracted when the source of light is over a cut-out portion of the card so as to fall in full intensity upon the cell. The switches are urged outwardly by springs so that when the light is cut off altogether the back contacts are engaged.

The back contacts control the circuit of motor relay solenoid 57 and the front contacts control the circuit of motor relay solenoid 58. These relays operate reversing switches of motor 46 so that the armature circuit is connected across the line in one direction when solenoid 57 is energized and in the other direction when solenoid 58 is energized. A feed-back 59 from the motor turns the compass head until the motor is deenergized.

Hence it will be understood that if for some reason the boat wanders off its set course, it moves the compass head with respect to the card and energizes the motor 46 one way or the other which turns the rudder and at the same time turns the compass head back to zero position. The return of the boat to its course causes the beam of light to pass on the other side of the cut-off edge and start to reverse the motor and straighten up the rudder while the boat is coming on to its course. Hunting is thus prevented and the result is that the boat comes smoothly back on to its course without overrunning it and the feed-back 59 leaves the head in the correct relation to the compass card.

Differentially combined with this feed-back is a course changing motor 60. The driven shaft 61 of this motor is connected by differential 62 into the feed-back 59. Therefore any movement of the armature of motor 60 moves the head of the compass and hence the line of the beam of light. The motor 46 is thereby energized and turns the rudder to cause the ship to assume a new course. The feed-back during this rudder positioning movement of motor 46 turns the compass head toward zero position at which the motor is cut off, but the turning movement of the ship in response to the rudder tends to carry the compass head past the zero position and reverse motor 46 and straighten up the rudder in time to prevent an overrun of the boat. Thus the boat is brought smoothly and accurately on to the new course, and the compass head in order to be on zero position now has a new relation to the center line of the boat.

For remote radio control the course changing

motor 60 is made responsive to relays 30 and 44. First the correct code number is dialed to actuate selector wheel 25 to the position to make contact 27. This closes both contacts 30a and 30b. Then contact 4 or 6 is closed, depending upon whether the course is to be changed to port or starboard. This causes impulses of either 600 or 1500 cycle frequency to be sent out, and relay 44 is thereby caused to move armature 42 on either contact 42a or 42b. This determines which of the slow operating motor contact relays 63 or 64 is energized. These control, respectively, the armatures 65 and 66 that cooperate with both front and back contacts. They are biased to their back contacts, as shown, and each on its forward contact closes the armature circuit of motor 60 which includes the other back contact. The motor is shown as series wound so as to be energized in one direction when relay 63 is energized and in the opposite direction when relay 64 is energized.

Let it be assumed that it is desired to change the course of an escorted boat to port. The operator on the escort ship first dials the code number of contact 27 and thus closes contacts 30a and 30b. He then closes contact 4 and causes the oscillator to send out impulses of, say, 600 cycles. This causes relay 44 to move armature on, say, contact 42a. This will energize relay 64 through lead 43, armature 42, contact 42a, lead 67, contact 30b, leads 68 and 69, solenoid 64, and lead 70 to the other side of the line. Armature 66 is thus pulled against its front contact and motor 60 becomes energized through lead 71, field winding 72, lead 73, armature 66, lead 74, the brushes and armature of the motor, lead 75, back contact of armature 65 and lead 70 to the other side of the line.

If switch 6 be closed so as to transmit impulses of 1500 cycles and move armature 42 against contact 42b, then relay 63 is energized as follows: lead 43, contacts 42 and 42b, leads 76 and 77, contact 30a, leads 78 and 79, solenoid 63 and lead 70 to the other side of the line. This attracts armature 65 and closes the circuit of motor 60 in the opposite direction as follows: lead 71, field winding 72, lead 73, front contact of armature 65, lead 75, brushes and armature of the motor, lead 74, armature 66 together with its back contact, and lead 70 to the other side of the line.

The consequent movement of motor 60 will be transmitted to the compass head through differential 62 and the boat will assume a new course as above explained. When the course changing motor has been caused to introduce the proper value, the motor is stopped by dialing selector wheel 25 so as to engage contact 33 and deenergize relay 30 and open the contacts 30a and 30b. Relay 63 or relay 64, whichever one was energized is thus deenergized, restoring its armature to the back contact and opening the motor circuit.

The radio compass operates upon the principle of that disclosed, for example, in the Moseley Patent No. 2,257,757, and may be used in conjunction with the automatic pilot above described to hold the boat on a definite course having a predetermined relation to its bearing relative to the escort ship. The controlling principle of the radio compass arises from the fact that a loop mounted to turn about a vertical axis and tuned to a selected radio signal will automatically seek a position perpendicular to the incoming wave front. In this way the loop can be caused to maintain a definite relation to the direction line be-

tween the escort ship and the cargo boat which is being directed. A radio signal is sent out from transmitter 1 and a loop 80 will through means disclosed in the said Moseley patent be automatically positioned perpendicular to the wave front. The loop which is thus relatively stabilized carries a contact 81 connected to the positive side of the line 32 and positioned to coact with two segmental contacts 82 and 83. These contacts are connected by leads 84 and 85, respectively, to the fixed elements of contacts 29a and 29b, respectively, the cooperative movable elements of which are connected with leads 68 and 78, respectively.

The contacts 82 and 83 are set angularly in a selected position with respect to the center line of the boat and the course is thus determined with respect to the facing of the loop 80. If contact 81 engages either contact 82 or contact 83 the course changing motor 60 is energized to introduce a change of course and thereby turn the boat and with it contacts 82, 83 until contact 81 is restored to neutral position.

Thus if the escorted boat is proceeding on a course under control of the radio compass and it starts to wander from its course, promptly contact 81 engages contact 82 or 83, depending on the direction of the error. To be under control of the radio compass contact 26 must have been dialed and relay 29 must be energized. Contacts 29a and 29b are therefore closed. If contact 83 is engaged relay 63 is energized as follows: from the plus side of line 32 to contact 81, contact 83, lead 85, contact 29b, lead 78, lead 79, winding 63 and lead 70 to the negative side of the line. If contact 82 is engaged relay 64 is energized as follows: from the plus side of the line, contact 81, contact 82, lead 84, contact 29a, lead 68, lead 69, winding 64 and lead 70 to the negative side of the line. In either case the course changing motor puts in the proper correction to bring the boat back on the original course. If desired means (not shown) such as a motor energized and controlled similarly to motor 60, may be provided to change the angular setting of contacts 82, 83 by radio remote control. In this way the course of the escorted boat relative to the direction of the incoming signal may be remotely changed.

As previously stated, relay 31 controls the contacts of the control relays for the throttle operating motor. This motor is numbered 86 and its control relays, which are also slow operating are numbered 87 and 88. Like relays 63 and 64, they control contacts that determine the direction of energization of motor 86, and relay 44 determines which of relays 87 and 88 is energized when solenoid 31 is energized. A cam arrangement operated by motor 86 controls series contacts in a holding circuit for relays 87 and 88 and will stop the motor when the next throttle position is reached, assuming of course that the circuit closers for the control relays which were closed by radio remote control, have been opened. Furthermore to prevent any uncertainty in the operation of the throttle changing motor, each of relays 87 and 88 control a back contact in the circuit of the other relay.

Assume that the operator dials contact 28 and then operates contact 5 and so broadcasts impulses of 600 cycle frequency, so as to energize coil 44a and attract armature 42 against contact 42a. Contacts 31a and 31b are closed and relay winding 88 is energized as follows: from the plus side of line 32 through lead 43, contacts 42 and 42a, lead 89, contact 31a, lead 90, back contact 91 of relay 87, lead 92, winding 88 and

lead 93 to the negative side of the line. This attracts armature 94 and closes the motor circuit as follows: lead 95, field winding 96, lead 97, contact 94, lead 98, brushes and armature of the motor, lead 99, back contact of armature 100 controlled by solenoid 87, and lead 93 to the negative side of the line.

This will cause the motor to turn in a direction to open the throttle, for example. If it be desired to reduce the throttle and turn the motor in the opposite direction, coil 44b is energized by pushing button 7 and broadcasting impulses of 1500 cycles. Armature 42 will thereupon engage contact 42b. This will cause relay winding 87 to be energized as follows: from the positive side of the line through lead 43, contacts 42 and 42b, lead 76, contact 31b, lead 101, contact 102, lead 103, winding 87 and lead 93 to the negative side of the line.

Motor 86 operates cam 104, the edge of which is engaged by three cam followers that are urged inwardly and will therefore drop into the low part of the cam. In so doing they individually break the holding circuit for relays 87, 88 as will be described.

In the construction diagrammatically shown the motor also operates the throttle 105 through the cam as a crank, by means of links 106, 107 and 108.

The relays 87 and 88 include holding contacts 109 and 110, respectively, connected in parallel in lead 111 that is connected to the idle speed contact 112 that is on one of the cam followers. The fixed coacting contact of the idle speed follower 112 is connected by lead 113 to the cam follower 114 that corresponds with the throttle position for intermediate speed. The third cam follower 115 is the full speed follower in that it drops into the low part of the cam when the throttle is in full speed position. The two fixed cooperating contacts of cam followers 114 and 115 are connected by lead 116, and the full speed cam follower 115 is connected to the positive side of line 32 by lead 117.

From the above it will be seen that when contact 28 has been dialed and the direction control relay 44 energized, one of control relays 87 and 88 will be energized and the motor 86 will start running. The cam follower that is on the low part of the cam and has broken its contact, will ride upon the cam and close its contact. This completes the holding circuit for the control relay and the original circuit through contact 31a or 31b will now be broken by dialing the shunting contact 33. The motor will continue to run until the next cam follower drops down into the cam depression which will break the holding circuit and deenergize the motor circuit by opening either contact 94 or 100. The result is that the motor will operate the throttle one step and will then stop, and will not start again until contact 28 is again dialed.

Other dialed contacts may of course be provided for other operating circuits. For example extra contacts 118 and 119 are shown which may serve engine stopping and engine starting circuits.

It will also be understood that it is very possible to provide means whereby the escorted boat may be caused to signal to the escorting ship upon demand information as to various controlled conditions. For example the course of the escorted ship could be intermittently or upon demand signaled to the escorting ship by means of short segmental contacts of a commutator

member (not shown) that would be successively engaged by a contact on the compass head and would cause different radio signals to be emitted which would be picked up and interpreted by the escort ship.

Similarly the three cam followers 112, 114 and 115 could close contacts 112a, 114a and 115a, respectively, in their inward positions which could be utilized to indicate the throttle position and hence the speed back to the escorting ship. The panel arrangement for this is indicated in Fig. 3. There are eight panels, one for each ship, as well as the one master control panel with the dial and the buttons for selectively controlling the several boats.

The eight panels are all alike. Each contains a key 120 which, for example, would cause a signal to be transmitted that would operate selectively to close the transmitting circuit on the boat the panel of which contains the key that is closed. Immediately a signal would come back according to the throttle position and hence according to which cam follower is in. The signal sent out thereby could be variously indicated on the panel. For example there may be three lights, as indicated, which will be selectively lighted according to the signal received and will indicate the possible positions of the throttle.

It will be appreciated that through the design of the cargo boats and the automatic controls certain definite advantages are derived which have both war time and peace time value. In spite of the fact that concrete is heavier than steel and to that extent cuts down the cargo carrying capacity, the design of the boat gives it considerably more dead weight carrying capacity than a boat of orthodox design of the same measurements would have. A portion of the weight of the boats of the novel design is put into the hull in the form of bulkheads to make water-tight compartments, thereby achieving the dual purpose of reinforcing the structure and making the boat practically unsinkable.

Moreover the design eliminates all requirements as to free board, crew accommodations and superstructure. This is rendered possible by the fact that the boat is remotely controlled and therefore can run either with a small, skeleton crew, or with no crew where the control is completely automatic.

Therefore not only is the cost of the boat as compared with orthodox designs considerably reduced, but the cargo carrying capacity is increased, in spite of the fact that it is built of concrete.

The construction herein diagrammatically represented and above described is intended to be merely illustrative of the invention, and it is manifest that the invention as pointed out in the appended claims may be variously otherwise embodied.

We claim:

1. A system of transportation comprising an escort ship and a plurality of escorted cargo boats forming a convoy, an apparatus on the escort ship adapted to transmit radio impulses, code means for controlling the sequence of impulses, radio receiving apparatus on each cargo boat tuned to receive the said impulses, a steering motor and a throttle operating motor on each cargo boat, control means for each motor, and selector means on each cargo boat arranged selectively to energize the said motors and responsive selectively to the controlled impulses.

2. A system of transportation comprising an escort ship and a plurality of escorted cargo boats forming a convoy, a radio transmitter on the escort ship adapted to transmit alternately impulses of two distinctive characteristics, code means for controlling the sequence of impulses, a steering motor and a throttle operating motor on each cargo boat, local control circuits for the motors, and selector means on each cargo boat responsive selectively to code impulses to energize the local circuits.

3. A system of transportation comprising an escort ship and a plurality of escorted cargo boats forming a convoy, a radio transmitter on the escort ship adapted to transmit alternately impulses of two distinctive characteristics, code means for controlling the sequence of impulses, a steering motor and a throttle operating motor on each cargo boat, local control circuits for the motors, a contact wheel on each cargo boat operative selectively to energize the local circuits, and selector means responsive to the code impulses to actuate the contact wheel.

4. A system of transportation comprising an escort ship and a plurality of escorted cargo boats forming a convoy, a radio transmitter on the escort ship adapted to transmit alternately impulses of two distinctive characteristics, code means for controlling the sequence of impulses, a steering motor and a throttle operating motor on each cargo boat, local control circuits for the motors, and means on each cargo boat for causing selective energization of the local circuits, said means comprising a radio receiver and a selector including means to separate the two frequency impulses received by the radio receiver, a relay oppositely pulsed by the two frequency impulses, and a step-by-step contact wheel controlling the local circuits and actuated one step by each double impulse of the relay.

5. A system of transportation comprising an escort ship and a plurality of escorted power driven cargo boats forming a convoy, a radio transmitter on the escort ship adapted to transmit impulses of two different frequencies, code means for controlling the sequence of impulses, two reversible electric motors on each cargo boat, one connected to operate the rudder and one arranged in control of the throttle of the power means, an energizing circuit for each motor including a source of electric power, a pair of reversing contacts for each motor circuit, radio receiving apparatus on each cargo boat tuned to receive said impulses, and selector means on each cargo boat responsive selectively to the said impulses and arranged selectively in control of the reversing contacts.

6. A system of transportation comprising an escort ship and a plurality of escorted power driven cargo boats forming a convoy, a radio transmitter on the escort ship adapted to transmit impulses of two different frequencies, code means for controlling the sequence of impulses, two reversible electric motors on each cargo boat, one connected to operate the rudder and one arranged in control of the throttle of the power means, an energizing circuit for each motor including a source of electric power, a pair of reversing contacts for each motor circuit, reversibly energizable solenoid means in control of each pair of reversing contacts, a circuit for each solenoid means reversibly connectable with the source of electric power, a magnetically controlled switch in each solenoid circuit, radio

receiving apparatus on each cargo boat tuned to receive the said impulses, and selector means on each cargo boat responsive selectively to said impulses and arranged selectively in control of the said switches.

7. A system of transportation comprising an escort ship and a plurality of escorted power driven cargo boats forming a convoy, a radio transmitter on the escort ship adapted to transmit impulses of two different frequencies, code means for controlling the sequence of impulses, two reversible electric motors on each cargo boat, one connected to operate the rudder and one arranged in control of the throttle of the power means, an energizing circuit for each motor including a source of electric power, a pair of reversing contacts for each motor circuit, reversibly energizable solenoid means in control of each pair of reversing contacts, a circuit for each solenoid means reversibly connectable with the source of electric power, a magnetically controlled switch in each solenoid circuit, radio receiving apparatus on each cargo boat tuned to receive the said impulses, selector means on each cargo boat responsive selectively to said impulses and arranged selectively in control of the said switches, and relay means responsive to the said impulses to connect the solenoid circuits selectively with the source of electric power.

8. A system of transportation comprising an escort ship and a plurality of escorted power driven cargo boats forming a convoy, a radio transmitter on the escort ship adapted to transmit impulses of two different frequencies, code means for controlling the sequence of impulses, two reversible electric motors on each cargo boat, one connected to operate the rudder and one arranged in control of the throttle of the power means, an energizing circuit for each motor including a source of electric power, a pair of reversing contacts for each motor circuit, reversibly energizable solenoid means in control of each pair of reversing contacts, a circuit for each solenoid means reversibly connectable with the source of electric power, a magnetically controlled switch in each solenoid circuit, radio receiving apparatus on each cargo boat tuned to receive the said impulses, a selector including means to separate the two impulses of different frequencies and to rectify the induced currents to direct currents, two relays each adapted to be oppositely pulsed by the two rectified currents, contacts controlled by one relay for oppositely connecting the solenoid circuits selectively with the source of electric power, and means selectively actuated by the other relay in response to the code impulses for selectively operating the switches.

9. A system of transportation comprising an escort ship and a plurality of escorted power driven cargo boats forming a convoy, a radio transmitter on the escort ship adapted to transmit impulses of two different frequencies, code means for controlling the sequence of impulses, two reversible electric motors on each cargo boat, one connected to operate the rudder and one arranged in control of the throttle of the power means, an energizing circuit for each motor including a source of electric power, a pair of reversing contacts for each motor circuit, reversibly energizable solenoid means in control of each pair of reversing contacts, a circuit for each solenoid means reversibly connectable with the source of electric power, a magnetically controlled switch in each solenoid circuit, radio re-

ceiving apparatus on each cargo boat tuned to receive the said impulses, a selector including means to separate the two impulses of different frequencies and to rectify the induced currents to direct currents, two relays each adapted to be oppositely pulsed by the two rectified currents, contacts controlled by one relay for oppositely connecting the solenoid circuits selectively with the source of electric power, and a step-by-step contact wheel actuable in response to the code impulses of the other relay for selectively energizing the magnetically controlled switches.

10. A system of transportation comprising an escort ship and at least one escorted cargo boat, the cargo boat being designed with respect to the relation of the center of gravity to the center of buoyance so that it is normally substantially submerged in the water with its deck substantially flush with the surface, power means for propelling and steering the cargo boat, controls for the power means, radio transmitting means on the escort ship, and receiving means on the cargo boat responsive to the radiant energy transmitted from the escort ship for automatically operating the controls.

11. A system of transportation comprising an escort ship having a transmitter of radio impulses, dial means for controlling the sequence of radio impulses according to a selected code, a plurality of cargo boats grouped about the escort ship and each having power steering and propelling means, controls for the power means, radio receiving apparatus on each cargo boat tuned to receive the impulses transmitted from the escort ship, and a selector operated by the received impulses and including a step-by-step member arranged to actuate the controls.

12. A system of transportation comprising an escort ship having a radio transmitter adapted to produce alternately and successively radiant impulses of two different frequencies, code means for controlling the sequence of impulses, a plurality of cargo boats grouped about the escort ship and each having power steering and propelling means, controls for the power means, radio receiving apparatus on each cargo boat tuned to receive the impulses transmitted from the escort ship, a selector for each receiving apparatus including a relay pulsed by two said impulses of different frequency, and a device actuated by the relay and operated selectively according to code to energize the controls.

13. A system of transportation comprising an escort ship having a radio transmitter adapted to produce alternately and successively radiant impulses of two different frequencies, code means for controlling the sequence of impulses, a plurality of cargo boats grouped about the escort ship and each having power steering and propelling means, controls for the power means, radio receiving apparatus on each cargo boat tuned to receive the impulses transmitted from the escort ship, a selector for each receiving apparatus including a relay pulsed by two said impulses of different frequency, and a rotative step-by-step device actuable by the relay and effective selectively in different positions to operate the controls.

14. A system of transportation comprising an escort ship and an escorted cargo boat, a radio transmitting apparatus on the escort ship, a rudder operating motor on the cargo boat, control relays for the motor, an energizing circuit for the relays, an automatic radio compass apparatus on the boat including a direction seeking loop and

tunable to a signal from the radio transmitting apparatus, reversing contacts in the relay circuit including a contact element positioned by the loop, a solenoid, a circuit maker and breaker in the relay circuit controlled by the solenoid, radio receiving apparatus on the boat responsive to radio impulses from the transmitting apparatus, and solenoid energizing means actuated by the output of the receiving apparatus.

15. A system of transportation comprising an escort ship and an escorted cargo boat, a radio transmitting apparatus on the escort ship, a rudder operating motor on the cargo boat, control relays for the motor, an energizing circuit for the relays, an automatic radio compass apparatus on the boat including a direction seeking loop and tunable to a signal from the radio transmitting apparatus, reversing contacts in the relay circuit including a contact element positioned by the loop, a solenoid, a circuit maker and breaker in the relay circuit controlled by the solenoid, radio receiving apparatus on the boat responsive to radio impulses from the transmitting apparatus, a second circuit maker and breaker connected in parallel with the first, a second solenoid in control of the second circuit maker and breaker, separate energizing circuits for the two solenoids, and selector means actuated by the output of the receiving apparatus arranged in selective control of the two solenoid circuits.

16. A system of transportation comprising an escort ship and an escorted cargo boat, a radio transmitter on the escort ship, an oscillator associated with the transmitter and adapted to generate impulses of audio-frequency modulation, code means for controlling the sequence of the audio-frequency impulses, a rudder operating motor on the cargo boat, control relays for the motor, an energizing circuit for the relays, an automatic radio compass apparatus on the boat including a direction seeking loop and tunable to a signal from the radio transmitter, a set of reversing contacts in the relay circuit including a contact element positioned by the loop, two pairs of circuit makers and breakers connected in parallel in the relay circuit, those of one pair being in series with said reversing contacts, a solenoid in control of each circuit maker and breaker, separate energizing circuits for the two solenoids, a radio receiver on the cargo boat, and selector means actuated by the audio-frequency output of the receiver and selectively responsive to the code impulses to control the two energizing circuits.

17. A system of transportation comprising an escort ship and an escorted cargo boat, a radio transmitter on the escort ship, an oscillator associated with the transmitter and adapted to generate impulses of audio-frequency modulation, code means for controlling the sequence of the audio-frequency impulses, a rudder operating motor on the cargo boat, control relays for the motor, an energizing circuit for the relays, an automatic radio compass apparatus on the boat including a direction seeking loop and tunable to a signal from the radio transmitter, a set of reversing contacts in the relay circuit including a contact element positioned by the loop, two pairs of circuit makers and breakers connected in parallel in the relay circuit, those of one pair being in series with said reversing contacts, a solenoid in control of each circuit maker and breaker, separate energizing circuits for the two solenoids, a radio receiver on the cargo boat, selector means actuated by the audio-frequency output of the

receiver and selectively responsive to the code impulses to control the two energizing circuits, a second set of reversing contacts in series with the other pair of circuit makers and breakers, and relay means selectively responsive to the received code impulses arranged in control of the said second set of reversing contacts.

18. In a radio control escort system for ships including an escort ship and an escorted power boat, a radio transmitter on the escort ship, a radio receiver on the escorted boat adapted to detect waves emitted from the transmitter, a throttle operating motor on the power boat, a power circuit for the motor including reversing contacts, relay means in control of the reversing contacts, a cam operated by the motor having a plurality of followers according to the number of throttle positions, an energizing circuit for the relay means including the cam followers and cooperating contacts in series, each follower being arranged to engage its contact when on a high part of the cam and to leave its contact when on a low part of the cam, a circuit maker and breaker in the relay circuit, a solenoid in control of the circuit maker and breaker, an energizing circuit for the solenoid, and control means for the energizing circuit actuated by the output of the receiver.

19. In a radio control escort system for ships including an escort ship and an escorted power boat, an oscillator on the escort ship adapted to generate radio impulses of two different frequencies, code means for controlling the sequence of the impulses, a throttle operating motor on the cargo boat, a power circuit for the motor including reversing contacts, relay means in control of the reversing contacts, a cam operated by the motor having a plurality of followers according to the number of throttle positions, an energizing circuit for the relay means including the cam followers and cooperating contacts in series, each follower being arranged to engage its contact

when on a high part of the cam and to leave its contact when on a low part of the cam, a circuit maker and breaker in the relay circuit, a solenoid in control of the circuit maker and breaker, an energizing circuit for the solenoid, and means responsive to the impulses of a sequence determined by the code means for controlling the energizing circuit.

20. In a radio control escort system for ships including an escort ship and an escorted power boat, an oscillator on the escort ship adapted to generate radio impulses of two different frequencies, code means for controlling the sequence of the impulses, a throttle operating motor on the cargo boat, a power circuit for the motor including reversing contacts, relay means in control of the reversing contacts, a cam operated by the motor having a plurality of followers according to the number of throttle positions, an energizing circuit for the relay means including the cam followers and cooperating contacts in series, each follower being arranged to engage its contact when on a high part of the cam and to leave its contact when on a low part of the cam, a circuit maker and breaker in the relay circuit, a solenoid in control of the circuit maker and breaker, an energizing circuit for the solenoid, means responsive to the impulses of a sequence determined by the code means for controlling the energizing circuit, a set of reversing contacts in the relay circuit to determine the direction of rotation of the motor, a solenoid in control of the said set of reversing contacts having two windings active in opposite directions, and means for energizing one winding with the output of the receiver from impulses of one frequency and for energizing the other winding with the output of the receiver from impulses of the other frequency.

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