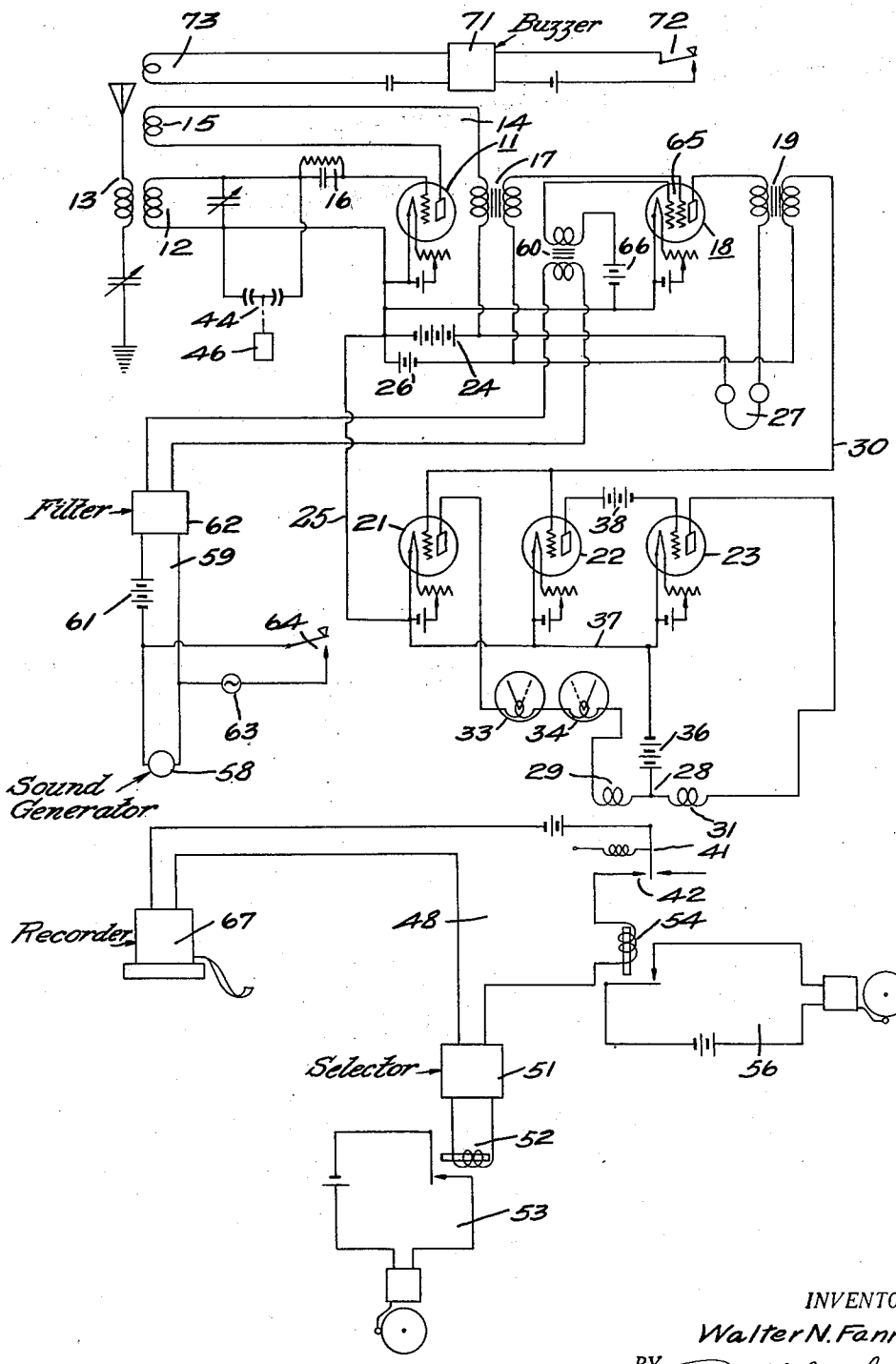
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SYSTEM AND APPARATUS FOR ASSISTING NAVIGATION

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SYSTEM AND APPARATUS FOR ASSISTING NAVIGATION

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This invention relates generally to apparatus for assisting navigation, particularly navigation of ships at sea.

It is a general object of the present invention to devise a system and apparatus for use on ships which will tend to prevent inaccuracies in navigation, and which will utilize a minimum of apparatus for performing several desired functions.

It is a further object of my invention to devise a method and system utilizing apparatus which will serve to prevent ship-wrecks on shore or collision between vessels at sea by imparting a danger or warning signal of positive character to the operator, and which will give a warning signal in the event that certain apparatus becomes inoperative.

It is a further object of the present invention to devise a system of the above character which can be utilized for continuous operation on conventional commercial radio wave lengths used for communicating between ships, say for example in the neighborhood of 600 meters.

It is a further object of the present invention to incorporate in a system of the above character means whereby the apparatus can be properly tested at regular intervals to insure its proper operation, and which will make a record of its operation for occasional examination.

It is another object of the present invention to devise a radio signaling system for use on ships which will be continuously operated to receive signals, and which will incorporate both means for automatically translating a received danger signal, as for example an SOS code signal, and will also give a response or alarm signal in the event that the ship so equipped approaches in the proximity of another ship or in proximity to a dangerous locality equipped with similar apparatus.

It is another object of the present invention to devise a radio apparatus for aiding navigation, parts of which can also be utilized for receiving submarine sound signals and for depth ranging.

It is a further object of the present invention to devise apparatus capable of giving a visual and audible warning of the presence of submerging, submerged, or broaching submarine vessels, thus preventing collisions with vessels of this character.

Further objects of the invention will appear from the following description in which I have set forth the preferred embodiment of my invention in conjunction with the accompanying drawing. It is to be understood that the appended claims are to be accorded a range of equivalents consistent with the state of the prior art.

The radio apparatus which I utilize in my system is preferably capable of simultaneously and continuously transmitting and receiving radio signals. In the drawing such apparatus has been represented by the electron relay tube 11, of the usual three element type, connected with circuits so as to operate regeneratively. The input or grid circuit 12 of relay 11 is coupled to a suitable tuned antenna circuit 13. The output circuit 14 includes a coil 15, which can be coupled with the input circuit 12, so as to secure a feed back of radio frequency energy. A grid condenser and grid leak 16 has been shown inserted in the grid circuit of relay 11. Transformer 17 serves to couple the output of relay 11, to the input of an electron relay audio frequency amplifier 18. Transformer 19 serves to couple the output of relay 18 with the electron relays 21, 22, and 23. As a source of B-battery current for the outputs or plate circuits of relays 11 and 18 I have shown a B-battery 24, and a C-battery 26 is included for the purpose of maintaining a proper bias upon the grid of relay 18. Translating means such as a pair of phones 27 have been shown inserted in the output of amplifying relay 18, to enable monitoring by an operator.

Electron relays 21, 22 and 23 are controlled according to the amplified output currents from the secondary of transformer 19, and serve in turn to produce amplified currents for operating a magnetic relay 28. This relay is preferably one having differential magnetic windings 29 and 31. Relay 21 has its grid connected with conductor 30, which in turn connects with the high potential secondary terminal of transformer 19. The low potential terminal of this secondary can be connected to the negative terminal of C-battery 26, to properly bias the grid of relay 21. The grid of relay 22 is likewise connected to conductor 30, and is therefore normally biased in the same manner as the grid of relay 21. The control circuit for relays 21 and 22 has been shown completed by a conductor 25.

The output circuit of relay 21 includes the series connected translating devices 33 and 34, as for example relatively sensitive current meters which can be read visually, and also the winding 29 of magnetic relay 28. The other magnetic relay winding 31 is included in the plate or output circuit of electron relay 23. As means for energizing the outputs of both electron relays 21 and 23, I have shown a B-battery 36 having its posi-

tive terminal connected to the point of connection between windings 29 and 31, and having its negative terminal connected to the common filament conductor 37 for the filament of relay 21, 22 and 23. The grid of electron relay 23 is connected to the negative terminal of a battery 38, the positive terminal of this battery being connected to the plate of electron relay 22.

Normally the bias provided by battery 26, upon the grids of relays 21 and 22, is sufficient to make the plate filament impedance of these relays 21 and 22 substantially infinite. Thus no current flow normally occurs in the output of electron relay 21. With the plate filament impedance of electron relay 22 infinite, it is apparent that battery 38 will have no effect upon the grid of electron relay 23, so that this relay 23 acts as if its grid were disconnected or open ended. Thus a normal current flow will occur in the output circuit of electron relay 23, and thru magnetic winding 31. When a signal is received by electron relay 11, the integrated audio frequency modulations are impressed upon amplifying relay 18, and the amplified current variations impressed upon the grids of relays 21 and 22. Thus the grids of these relays become less negative or more positive, so that the plate filament impedance of both relays becomes of finite value. Thus when signal energy is being received, a normal current flow will occur thru the indicating devices 33 and 34, and thru magnetic winding 29. At the same time, since the plate filament impedance of electron relay 22 becomes finite, a circuit is formed for battery 38, so that this battery functions to place a negative bias upon the grid of electron relay 23 sufficient to make the plate filament impedance of this relay substantially infinite. Therefore when signal energy is being received, a current flow occurs thru magnetic winding 29, and thru devices 33 and 34, but the current flow thru winding 31 is reduced to substantially zero.

Magnetic relay 28 is provided with an armature 41 normally biased towards its contact 42. However the normal current flow thru winding 31 when signal energy is not being received, normally retains armature 41 away from contacts 42. When signal energy is received, energization of winding 29 accompanied by reduction of the current in winding 31, causes the armature 41 to close, and remain closed until the signal energy ceases. It is understood of course that by signal energy I refer to energy which is of tone frequency when impressed upon relay 18. Relay 28 is of course adjusted so that its armature will not flutter in accordance with the audio frequency variations.

The regenerative operation of electron relay 11 is preferably made such that this relay and its associated circuit will not only serve as a detector of radio frequency signals, but also as a transmitter of oscillations of substantially the same frequency. In other words this regenerative detector serves to reradiate radio frequency energy to such an extent as to be effective for reception by a like apparatus located within a given radius. In this connection it may be explained that I preferably provide a plurality of vessels with the apparatus described above, so that two vessels so equipped will automatically exchange radio energy when they approach in proximity to each other. In order to insure proper and simultaneous exchange of signals between two like systems such as described above, I preferably periodically vary the tuning of the circuits associated with electron relay 11. In this particular instance this is accomplished by providing a relatively small variable condenser 44, driven by suitable means such as a motor 46, and connected across the tuned input of electron relay 11. Condenser 44 varies the tuning of the input of relay 11 within a given wave length channel, so that heterodyning with incoming signals from a like system, to secure an audiofrequency beat note for amplification, is insured. It is of course evident that when a plurality of such radio apparatus are installed upon different ships, for simultaneous exchange of energy, it will be practically impossible for the condensers 44 to be in absolute synchronism. Furthermore the variation in tuning afforded by condensers 44 of two apparatus installed upon different ships, is not sufficient to preclude reception of an audible frequency beat note. Thus assuming that two ships are equipped with apparatus such as described above and are in proximity to each other so as to exchange radio energy, if the condenser 44 of one apparatus should at one instance be at maximum setting, and the condenser of the other apparatus at minimum setting, a varying beat note would still be secured by both apparatus.

While the apparatus described above may be arranged to operate upon any desired frequency channel, I preferably have it operating upon a commercial wave length channel of say 600 meters. This makes it possible to incorporate not only translating means for indicating the proximity of another vessel similarly equipped, or proximity to a radio station located on land, but also to provide suitable means responsive to an SOS or similar radio distress signal. Thus I have shown a circuit 48 controlled by the armature and contact 42 of magnetic relay 28, and which includes an SOS code selector 51. The output of selector 51 is connected to a magnetic relay 52, which in turn serves to control a local alarm circuit 53. The selector 51 is constructed so as not to respond to ordinary telegraphic coding received by magnetic relay 28, but will respond to the coding of an SOS signal, or equivalent conventional signal of distress. Thus when a distress signal is received, relay 52 is automatically closed, to close the alarm circuit 53, and thus apprise the operator that a distress signal is being received.

It is evident that when my apparatus comes into proximity with another similar apparatus, relatively long sustained signals will be received as distinguished from the interrupted impulses characterizing the conventional telegraphic code and SOS signals. In order to secure a characteristic indication responsive to such long sustained signals, I provide a delay relay 54, having its winding connected in series with circuit 48. The contacts of relay 54 control a local alarm circuit 56. The action of relay 54 is delayed to such an extent that it will not close this armature for ordinary telegraphic signals, or for SOS signals. However when long sustained signals are received, relay 54 is operated to close the alarm circuit 56.

On many vessels apparatus is provided for transmitting and receiving submarine signals of audible frequency. Such apparatus is often employed for depth ranging, that is, to determine the depth of water beneath the vessel. In depth ranging sound waves of a definite frequency are generated by suitable apparatus and directed downwardly. By detecting and noting the time lapse between the instant the sound waves are transmitted, and the instant they are received,

the depth of water beneath the vessel can be calculated. As representative of such apparatus I have indicated a device 58 which is located beneath the surface of the water, and which will function to generate and transmit sound waves thru the water when excited with alternating current, and which will also serve to translate received sound waves into current variations. A circuit 59, including a source of current 61, serves to connect this device 58 with a suitable filter 62, tuned to a definite audible frequency channel, say in the neighborhod of 1000 cycles. For exciting device 58 to generate sound waves, I have indicated an oscillator or alternating current generator 63 which can be connected to device 58 by closing key 64. In place of providing separate and individual apparatus for translating the signals from circuit 59, I preferably utilize at least a portion of the radio signaling apparatus described above. Thus in practice I can connect the tuned filter 62 to the input of audio frequency amplifier 18. Suitable means for effecting this result consists of an audio frequency transformer 60, having its primary connected to tuned filter 62. One terminal of the secondary of transformer 60 is connected to an extra grid 65 of relay 18, and its other terminal connected to filament of electron relay 18 thru a suitable biasing battery 66. This particular means for connecting tuned filter 62 with electron relay 18 has been provided in order to utilize the amplifying characteristics of relay 18, and in order to obviate modulating the high frequency oscillations being generated by electron relay 11.

In combination with the submarine signaling means described above, it is desirable to incorporate suitable recording means, such as the tape recorder indicated at 67. This recorder can be either of the tape perforated type, or of the type utilizing an inking stylus. A convenient point to connect recorder 67, is in the circuit 48 as shown.

When the above described apparatus is in normal operation, recorder 67 preferably is adjusted so that its tape moves at a constant predetermined speed. If the pilot or operator desires to determine the depth of water beneath the ship, key 64 is closed for an instant, to transmit sound waves downwardly from the ship. The current variations from oscillator 63 not only affects device 58, but are also transmitted to the tone filter 62 and transformer 60, and are impressed upon the grid 65 of electron relay 18. Correspondingly amplified current variations in the output of electron relay 18, are further amplified by electron relay 21, to effect operation of magnetic relay 28. A record is therefore immediately made upon the tape of recorder 67. When the reflected sound wave is received by the device 58, the current variations thereby produced are likewise impressed upon electron relay 18, and are caused to operate magnetic relay 28. Therefore a record of the reception is likewise made upon the tape of recorder 67. Since the tape moves at a definite predetermined speed, by noting the record upon the tape, the time required for the reception of the reflected sound waves can be determined, and the depth of water beneath the ship calculated. The apparatus can be similarly employed to calculate the distance from a given station equipped with means for simultaneously transmitting sound and radio signals.

In addition to making a record of the transmission and reception of submarine signals, it is also evident that recorder 67 will record signals which operate the SOS recorder 51, and the alarm circuit 56.

In order to make possible testing of the above apparatus, and to produce a record whereby it can be readily determined whether or not the apparatus has been properly functioning over a certain period, I can provide test means such as a buzzer 71, adapted to be operated by a closer key 72. A small loop circuit 73 can be connected with buzzer 71, and associated with the other apparatus so as to effect a test signal upon closing key 72. Circuit 73 can be in the form of a small dummy antenna associated with the main antenna circuit 13, or can be provided with a coil coupled to the input of electron relay tube 11 as shown. The regulations under which my apparatus is employed can require that the apparatus be tested at regular intervals, by closing key 72. If the recorder 67 is operated by such a test signal, as is evidenced by the record upon the tape, then the apparatus is properly functioning. If such test signals are made regularly over a long period, examination to the tape from recorder 67 which has been passed thru the recorder during such period, will show that the apparatus has been properly functioning and tested as required.

I claim:

1. In a system of the character described, radio receiving means adapted to be operative continuously, and adapted to reradiate signal energy, selecting means responsive to a conventional distress signal and connected to said radio means, and alarm means connected to said radio means and operative in response to the reception of signal energy of sustained duration from a substantially similar apparatus, said last means being unresponsive to said distress signal and to conventional telegraphic signals.

2. In a system of the class described, continuously functioning radio receiving and regenerating apparatus installed upon a plurality of ships which navigate within the same general locality, the apparatus on each ship including an antenna, an oscillating electron relay coupled to said antenna, and translating means coupled to said electron relay, said apparatus serving the double function of radiating a warning signal to other nearby vessels similarly equipped and of receiving and translating a warning signal from said other vessels simultaneously.

3. In a system of the class described, continuously functioning radio apparatus installed upon a plurality of ships which navigate in the same general locality, the apparatus on each ship including an antenna, an oscillating electron relay regeneratively connected to said antenna, a tuned circuit including a constantly varying condenser of small capacity whereby the tuning of said circuit is continuously varied within close limits, and translating means coupled to said electron relay, the radiations of said apparatus serving as a warning signal to nearby vessels similarly equipped and said translating means serving to translate a warning signal from said other vessels.

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