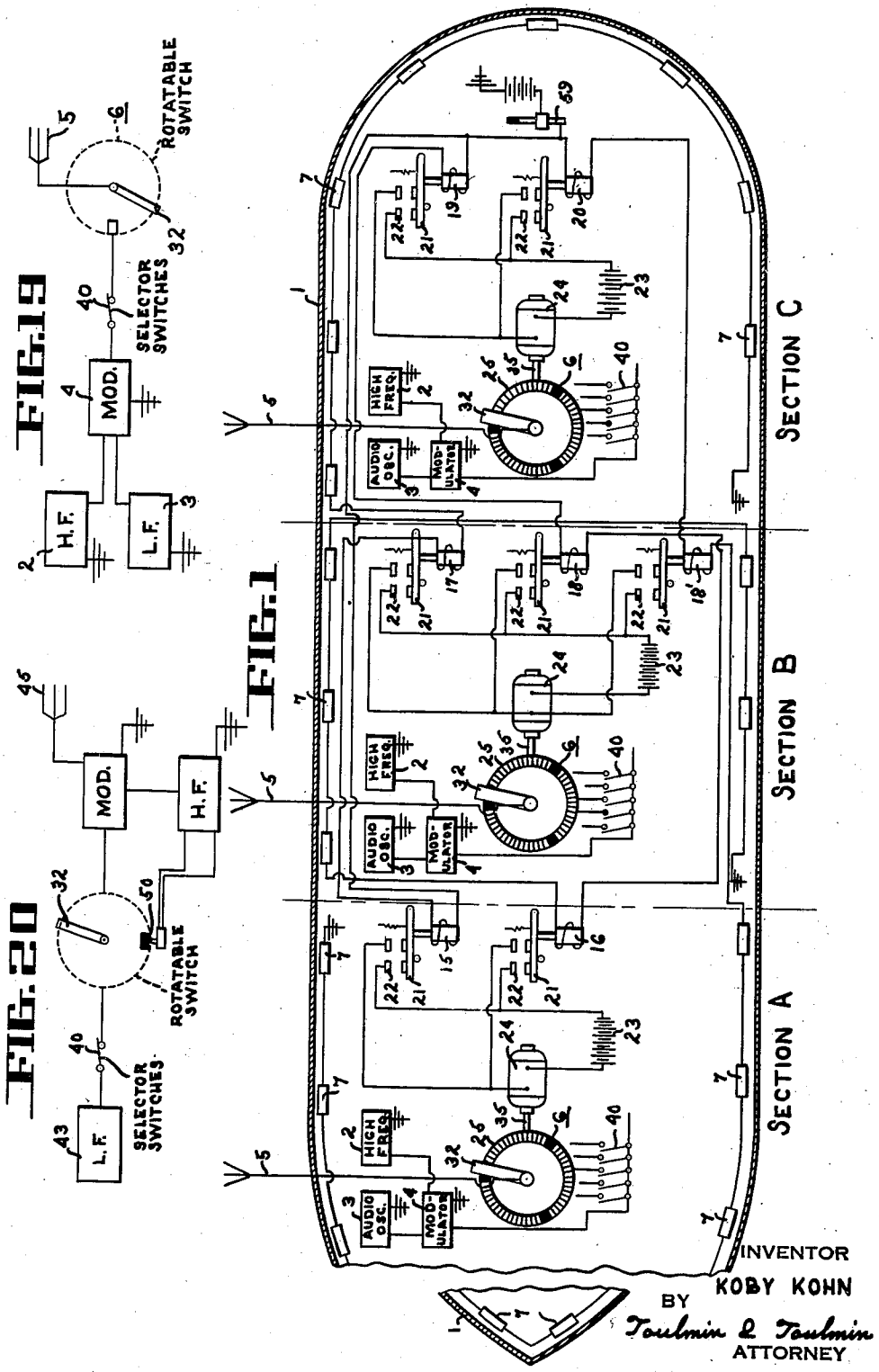
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METHODS OF AND APPARATUS FOR SIGNALING

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FIG. 2

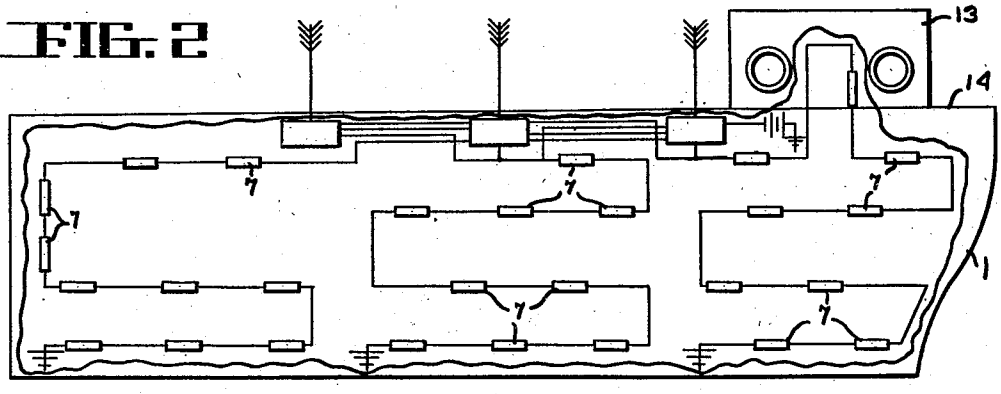


FIG. 3

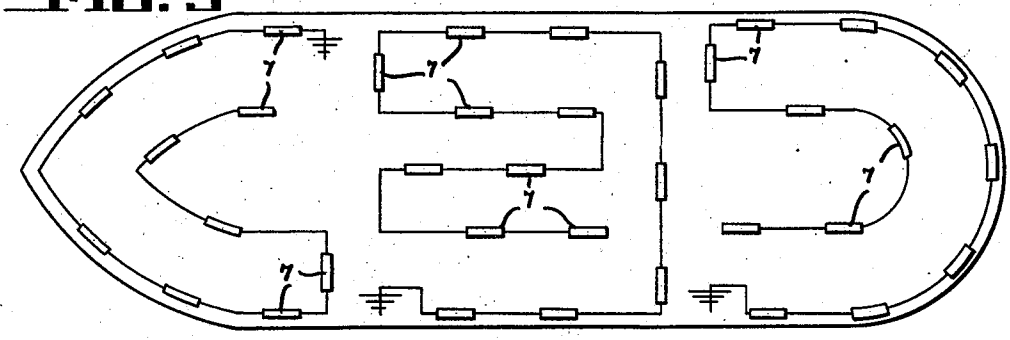


FIG. 4

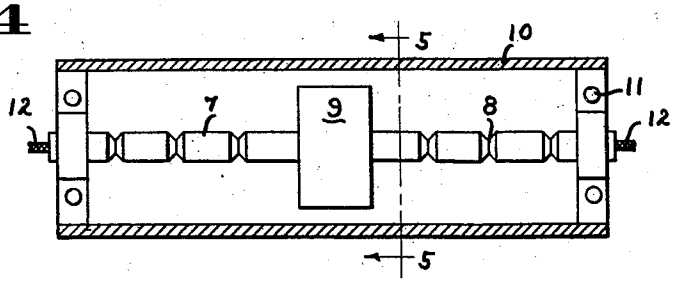
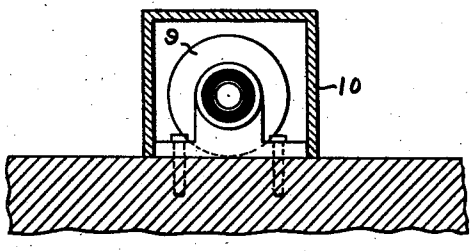


FIG. 5



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FIG. 6

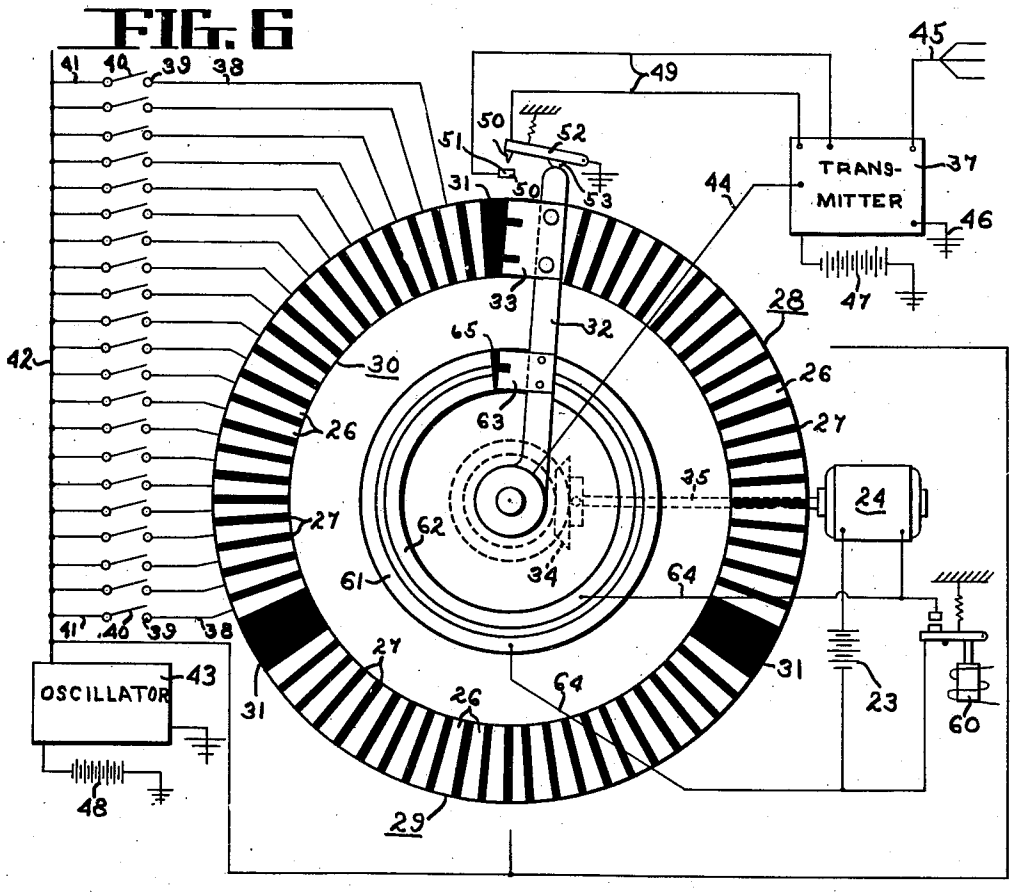
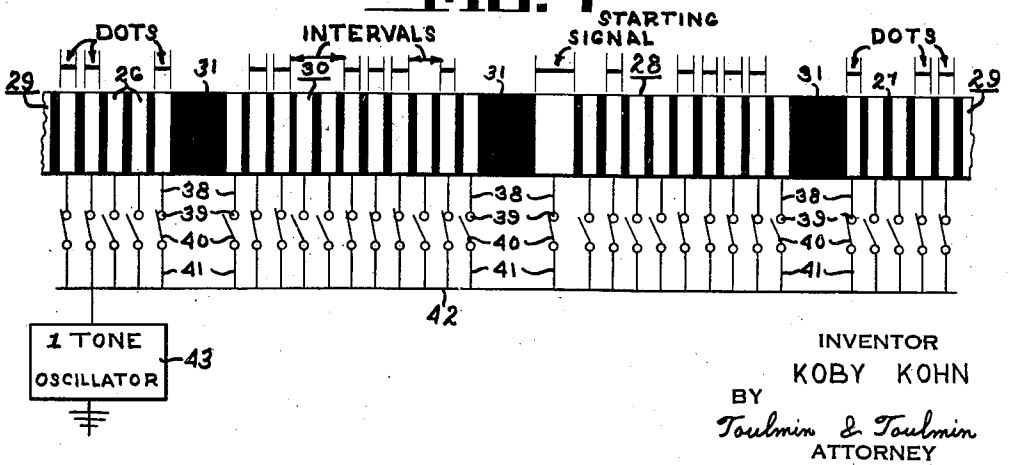


FIG. 7



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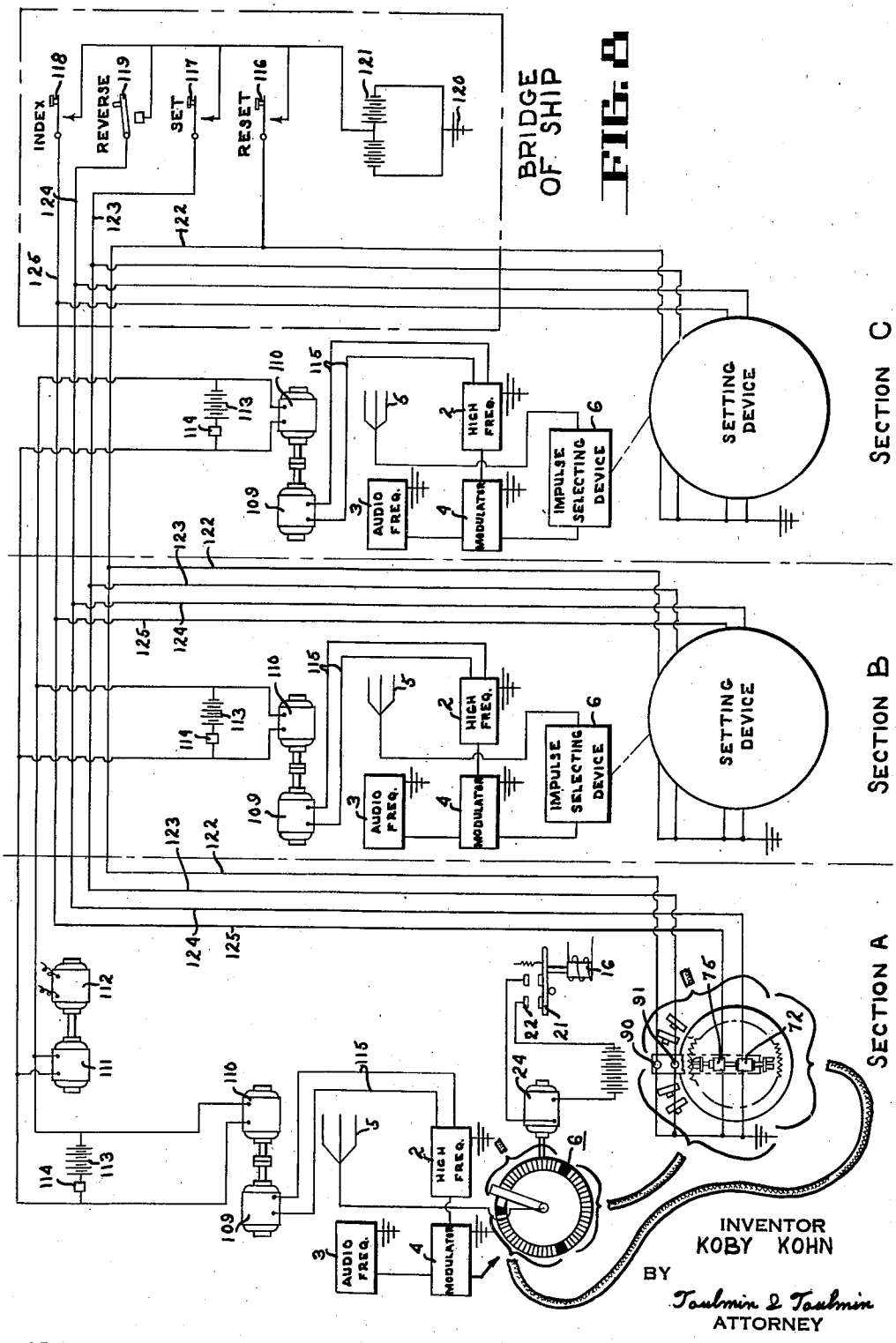


FIG. 8

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FIG. 9

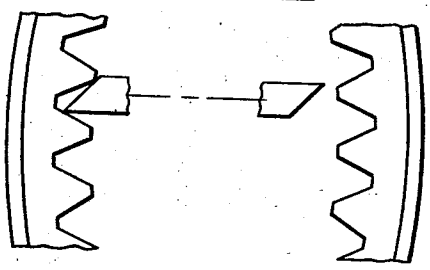


FIG. 10

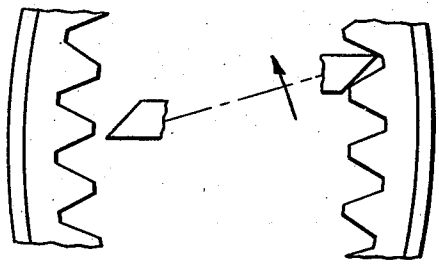


FIG. 11

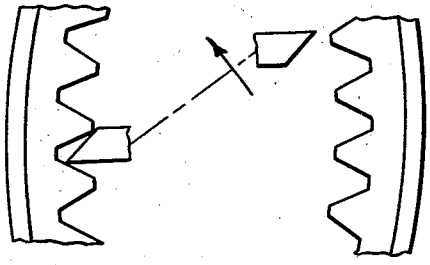


FIG. 12

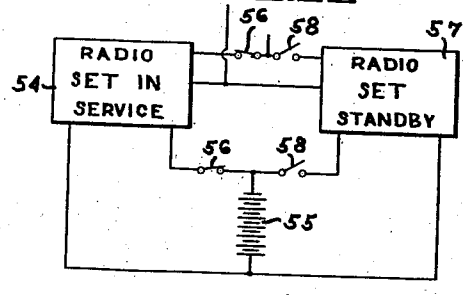
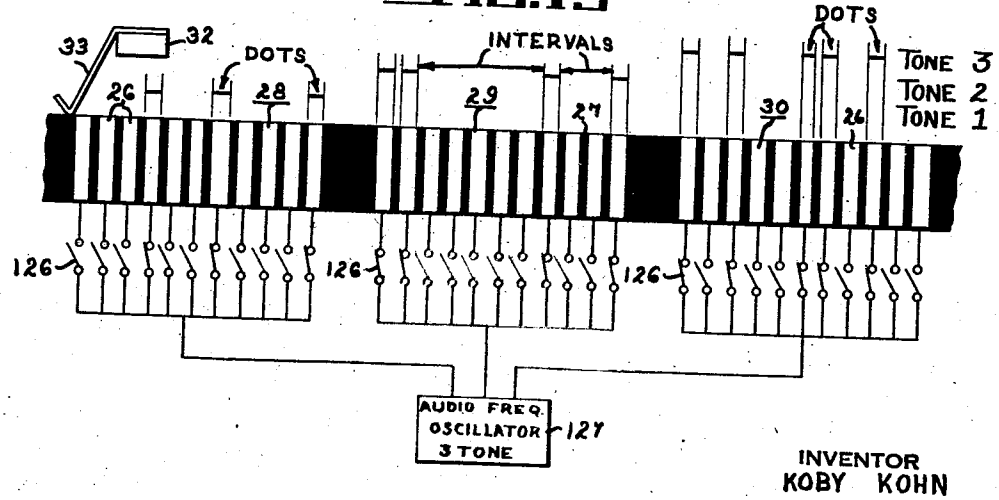


FIG. 13



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FIG. 14

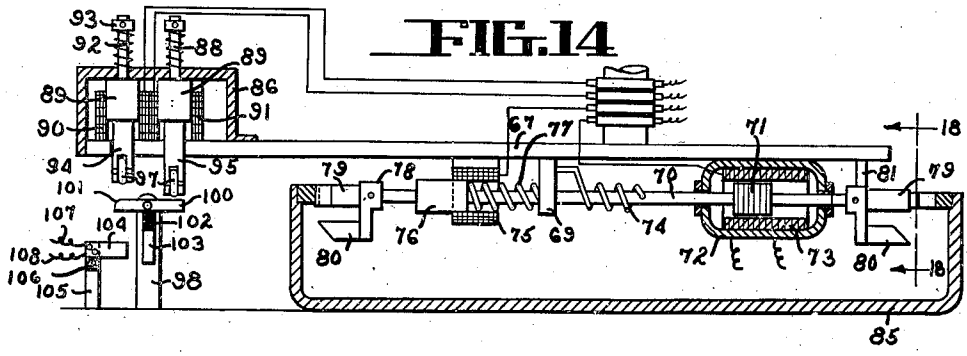


FIG. 16

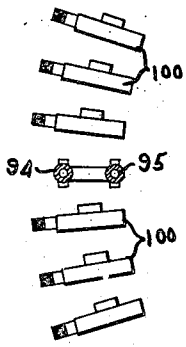


FIG. 15

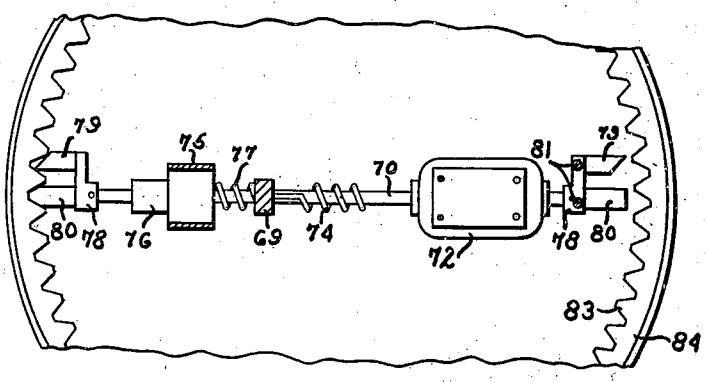


FIG. 18

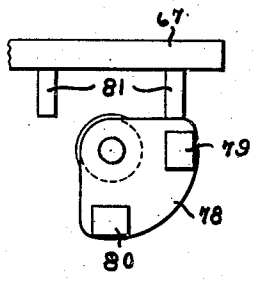
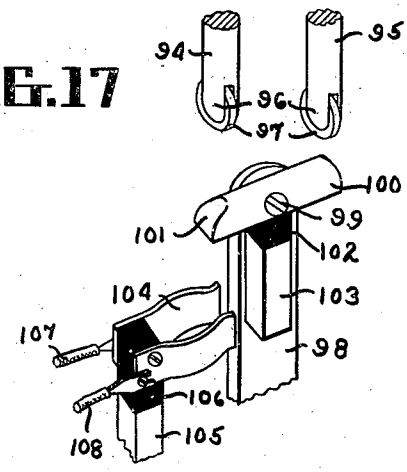


FIG. 17



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UNITED STATES PATENT OFFICE

2,389,786

METHOD OF AND APPARATUS FOR SIGNALING

Koby Kohn, New York, N. Y., assignor to Arthur F. Hubbard, Tipp City, Ohio

Application October 6, 1942, Serial No. 460,973

10 Claims. (Cl. 177—380)

The present invention relates to automatic signaling systems, more particularly to methods and apparatus for transmitting signals from a ship under emergency conditions.

When a ship is being shelled or torpedoed, the attacking vessel concentrates on the radio room, the antennae and boilers in order to prevent the transmission of help signals. The attack is usually started without warning under the cover of darkness and the first notice that the radio operator has of the attack is a devastating explosion in the wireless room. The attacker is then in a position leisurely to finish off his prey without opposition from any other war craft that might have been within calling distance of the attacked ship.

The primary object of the invention is to provide improved methods of and apparatus for instantly and automatically informing listeners on shore or on friendly ships of an enemy attack on a ship, accidental striking of a mine or other catastrophe to the ship. Another object is to provide an intelligence transmitting system which automatically starts functioning upon substantial damage to any part of the ship including the radio room and continues in operation as long as any appreciable part of the ship remains afloat and a supply of energy is available.

Still another object is to provide an emergency signaling system which is instantly set into operation when any vital part of the ship is severely damaged, this operation taking place without any assistance whatsoever from the personnel of the ship other than the predetermination of the message to be sent and adjustments of the apparatus prior to the sustainment of the damage. A further object is to provide an emergency radio signaling system for a ship and in which data concerning the ship, such as name and approximate position are automatically transmitted when any part of the ship's hull is pierced or other critical damage done.

A still further object is to provide a ship radio signaling system which is so arranged that regardless of the position of the damage to the hull, predetermined signals will be transmitted and will continue to be sent out until normal conditions have been restored or the ship has sunk.

Another object is to provide a signaling system for a ship in which the signals are of a predetermined character and can be manually changed directly, or changed by remote control depending upon the ship's movements.

A still further object is to provide a ship signaling or broadcasting system employing a plurality of antennae secretly positioned in different parts of the ship and tuned to different carriers in order to transmit on several frequency bands, thus reducing the liability of having the signals jammed or blanketed by the attacking vessel.

Other objects of the invention are: to provide a radio signaling system for use on water or air vehicles and in which signals representing position data in terms of longitude and latitude are automatically transmitted when the vehicle becomes critically damaged; to separate the various parts of the signal from one another by space or tone effects in order to facilitate the reception of the message; to provide entirely complete radio transmitting sets throughout the parts of the ship least likely to be damaged but to extend from these sets rupture responsive devices into those parts of the ship which are apt to receive a torpedo or shell; to provide standby or auxiliary tubes for each transmitting set with automatic means for switching from the regular tubes to the spares after certain time intervals; to provide an improved pre-setting and resetting device for controlling the character of the impulses that will automatically be transmitted from the ship under emergency conditions; to provide a simple and highly effective structure which automatically sets the transmitting system or systems into operation upon damage to the ship, regardless of the inaccessibility or remoteness of position of the damage; to provide a structure of the character set forth in all of the foregoing objects which lends itself readily to all types of ship designs and which may be readily applied to a ship in any stage of completion or when entirely complete.

The general object of the invention is to provide improved methods and apparatus for automatically broadcasting and without human assistance at the time of broadcasting, such information regarding the ship being attacked as to name, longitude and latitude in order to give the alarm to shore stations or nearby war ships.

The above objects are attained in brief by providing two or more separate transmitting sets, complete in every detail including separate antennae and separate sources of energy, positioned at segregated points on the ship. Frangible current conducting elements or feelers are distributed throughout the hull of the ship and are so arranged and connected to their respective transmitting sets that when any one of the elements is fractured, a predetermined group of transmitting sets start immediately to broadcast at different wave lengths a series of signal impulses which had been previously set or adjusted according to the instantaneous position of the ship at the time of the emergency. The pre-setting function may be accomplished manually at the position of each set by telephonic communication from the bridge or automatically by operating in proper sequence a switching device located on the bridge and controlled by the navigator. These individually and automatically operated radio sets will therefore transmit the code signals pre-

determined by the manual or automatic set by the navigator and damage to one part of the hull or to any one or even two of the radio sets will not prevent the remaining sets from instantly transmitting information concerning the ship.

The invention will be better understood when reference is made to the following description and accompanying drawings in which:

Figure 1 is a schematic view showing the application of the protective apparatus to a vehicle exemplified as a ship.

Figures 2 and 3 are diagrams indicating respectively the elevational and plan views of a ship and showing the disposition of the protective elements throughout the ship in order to afford the greatest amount of protection to vulnerable areas.

Figure 4 is an enlarged sectional view of one of the protective elements which are scattered throughout the ship.

Figure 5 is a sectional view of the protective elements shown in Figure 4 and taken along line 5—5 in that figure.

Figure 6 is an enlarged fragmentary plan view but partly schematic, of the combined setting and rotary switch mechanism, including electrical circuits for selectively applying signal impulses to a radiating antenna.

Figure 7 is a development of the setting and rotary switch mechanism shown in Figure 6 to explain the manner in which the impulses are set and transmitted.

Figure 8 is a schematic view of an automatic signaling system in which the control of the impulse selecting apparatus is accomplished automatically from a position remote from the apparatus. In practice this remote position would be the bridge of the ship as indicated in Figure 8.

Figures 9, 10 and 11 are diagrammatic views of the driving pawls and stationary rack forming part of the selector switch and showing successive positions of the pawls and their supporting spider as the pawls are operated.

Figure 12 is a schematic view of a standby or spare radio set arrangement which lends itself to the improved system and apparatus as a protection against breakdown.

Figure 13 shows a modification of the rotating switch in developed form to provide separate and discriminating tones for the various parts of the message which is automatically transmitted.

Figure 14 is a transverse sectional view, partly in elevation of the indexing selector switch mechanism including the setting and resetting devices.

Figure 15 is a fragmentary plan view of the indexing spider and its stationary rack while Figure 16 illustrates a portion of the end elevational view of the structure shown in Figure 15.

Figure 17 is a fragmentary perspective view of one unit of the selector switch including a part of the setting and resetting mechanism.

Figure 18 is an end view of one of the pawl holders shown in Figures 14 and 15. This view is taken approximately at the line 18—18 in Figure 14.

Figure 19 is a schematic view showing the essentials of the circuit illustrated in Figures 1 and 8 while Figure 20 shows broadly the essentials of the circuit employed in Figure 6.

General arrangement of the improved apparatus

In general, the improved system includes the use of a plurality of radio transmitting sets, complete within themselves and located at strategic positions throughout the ship or other vehicle. Each of these radio sets includes impulse control apparatus which may be set from time to time in any suitable manner and in accordance with predetermined messages but the set remains quiescent until an emergency arises. In order to start the set into operation, a number of circuit controlled devices are distributed throughout the vulnerable areas of the ship and these devices are preferably of a frangible character and so arranged with respect to their respective sets that when broken by the force of an explosion the radio or sets associated therewith start immediately to send out the predetermined signals.

The impulse control device is constituted preferably of a rotating switch and a selector switch, the first of which serves to apply to the radio set the predetermined impulses in succession while the other switch permits setting and resetting of the impulses to connote any desired message prior to the occurrence of the emergency. The selector switch may be set or reset from a position directly at the radio set or preferably from the bridge of the ship by remote control so that the message may comprise the name of the ship and its approximate position in terms of code signals which are immediately radiated at the antenna when any part of the ship's hull or gear is critically damaged.

The radio sets preferably have their own antenna and as illustrated in Figure 1, one set is positioned at the forward end of the ship preferably in the hold where it obtains the greatest protection. Another set may be placed amidships and a third set is positioned at the stern of the boat. These sets are preferably contained in water-proof casings, hermetically sealed if possible and constitute the usual high frequency oscillator, the low frequency or audible tone oscillator, the transmitting modulator tube together with the necessary power supply circuits and the only elements which extend to the exterior of these casings are the electrical circuits for setting or resetting the impulses to be transmitted and the circuits which lead to the frangible control devices distributed throughout the ship. The arrangement is such that one group of frangible control devices, for example the group positioned near the bow of the ship are associated with the midship and stern radio sets so that if a torpedo or shell should strike the bow the radio sets in the remaining or undamaged portions of the ship will be immediately set into operation.

Likewise, the frangible control elements protecting the midship portion are connected to the bow and stern radio sets while the controlled elements at the stern are associated with the forward and midship radio sets. Thus the apparatus and electrical connections are such that every part of the vulnerable areas about the ship including the radio shack is given protection in the sense that any material damage done in any part of this area will immediately and automatically cause radio signals to be sent out, which signals are of a predetermined character and in general may represent the name and position of the ship in order to notify rescuers or an avenging ship, bomber or torpedo plane.

Elements scattered throughout the ship for controlling the on and off conditions of the radio sets

Referring more particularly to Figure 1, reference character 1 designates the hull of a vehicle typified as a ship and for convenience of explanation the ship has been divided into the forward, midship and stern sections designated A, B, C re-

spectively. In each of these sections there is positioned a radio set complete in every detail including its own source of energy and antenna. As illustrated the radio set may comprise a carrier frequency oscillator 2 and an audible or low frequency oscillator 3, a modulator 4 for combining the high and low frequencies and for applying the composite frequency waves to the radiating antenna 5 or other transmitting device.

It is apparent that such a device may comprise a blinker system, under water supersonic transmitting system or a broadcast audible signaling system when suitable changes are made in the transmitting apparatus to accommodate the character of the broadcasting device. However, I prefer to employ an antenna for this purpose together with conventional radio apparatus on account of the greater distances that the signals may be broadcast under these conditions. In order to select the manner in which the impulses are applied to the antenna 5, there is provided a combined pre-setting switch and rotary switch mechanism indicated generally by the reference character 6. The details of this mechanism will be described in connection with other figures.

As stated hereinbefore, each radio set and its associated impulse control apparatus are preferably maintained as a unit and contained in a hermetically sealed casing although it will be understood that this is optional. The only circuits which leave the casing are those necessary to provide for the pre-setting operation and auxiliary sources of energy supply together with the individual protective elements which are positioned throughout the vulnerable areas of the ship.

The latter may comprise any type of electrical conducting member, readily frangible when positioned near an explosion so as to interrupt a circuit passing through the member and which circuit constitutes a control circuit of the radio set or sets with which the member is associated. As illustrated in Figures 4 and 5, such a member may be made of a solid metal rod 7 of extended character and having throughout its length portions 8 which are of restricted area in order to facilitate breakage of the rod. An enlarged portion 9 is also provided for the latter purpose to give an added swing to the rod when an explosion occurs. The frangible element may be contained in a casing 10 of any suitable shape, rectangular as shown and having a portion which is transparent in order that the condition of the element may be readily inspected. The ends of the casing are provided with bolts or screws 11 by which the casing may be secured to any part of the ship. Conductors 12 are taken through these end portions in any convenient manner so as to include the element 7 as part of an electrical circuit.

As shown in Figures 1 to 3 there is a large number of these elements 7 distributed throughout the ship and preferably positioned throughout the vulnerable areas of the ship including the hull 1, the radio shack 13 and the various decks 14, the latter being vulnerable to bomber attack. The protective elements 7 positioned at the forward section A (Figure 1) of the ship are associated in series relation with the circuits which control the actuating device of the radio sets positioned in the midship and stern sections B, C of the ship. Should any one of these elements 7 be disrupted by the force of an explosion, by torpedo or overhead bomber or shelling effects the series circuit through that element is broken and this causes the actuating device of the radio sets in sections B, C to be energized, thus immediately to cause transmission of signals from the midship and stern antennae 5.

The protective elements 7 which are distributed about the midship section of the hull serve when fractured, to break a series circuit which causes the actuation of the impulse transmitting device of the sets positioned in all sections including sections A and C. Likewise, the protective elements 7 in section C which might also include the radio shack 13 (Figure 2) serve upon being fractured, to cause actuation of the impulse transmitting systems positioned in all sections including sections A and B. It will be noted that the radio sets which are operated upon fracture of their respective groups of elements include those which are positioned remote from the position of those elements in order to reduce any tendency for the radio sets to be put out of commission by the torpedo, shell or bomb which had devastated that section of the ship in which the protective element had been ruptured.

The specific manner in which the protective elements 7 control the operation of their remotely positioned radio sets is typically exemplified by the use of electromagnets 15, 16 of section A, 17, 18 and 18′ of section B, and 19 and 20 of section C. The armatures of these electromagnets 21 are provided with double contacts 22 which form part of a circuit passing through a source of energy 23 and a motor 24. The electromagnets are so arranged that when their associated protective elements 7 are intact the circuits to the motors remain open and this is the condition illustrated in the drawings. The motor 24 constitutes the actuating device for the rotatable switch portion 25 of the combined selector switch 6. This rotary switch element will now be described.

Rotary switch portion of the combined selector switch 6

The rotary switch element or portion is illustrated in Figures 6 and 7 and as shown, may consist of a plurality of segments 26 of conducting material and separated from one another by thin pieces of insulation 27. These segments when assembled form a circular member and may be held in this position by any suitable type of clamping device (not shown). The circular member is divided preferably into three sections indicated generally by the reference characters 28, 29 and 30, these sections being divided from one another by a relatively wide piece or strip of insulation material indicated at 31. The number of segments in sections 28, 29 and 30 will depend on the nature of the message or signal to be automatically sent when an emergency occurs. In general, section 28 will have as many segments as are necessary to produce dot impulses and intervals of various lengths between each group of dots to convey a message for example the name of the ship, nationality, etc.

Section 29 will have as many segments as are necessary to transmit by dots and variable intervals between the dots the instantaneous longitude of the ship in terms of degrees, minutes and seconds. For example, if the instantaneous position of a ship is 179°, 59′, 59″ west, there should be enough segments to denote in sequence the numbers 1, 7, 9, then an interval, then the numbers 5, 9, then another interval, then the numbers

5 and 9 and another interval, finally a code signal corresponding to the letter W.

Likewise, section 30 should be constituted of as many segments as may be necessary to connote a telegraphic message concerning the instantaneous latitude of the ship in terms of degrees, minutes, seconds north or south of the equator. For example, if the latitude message be transmitted as 49°, 59′, 59″ south, the number of segments should be such as to provide first the 4 impulses, then the 9, then an interval, then 5 impulses and then 9 impulses, then an interval, then 5 impulses and 9 impulses followed by the code signal for north. Thus the information conveyed by the segment sections 28, 29 and 30 is transmitted in the form of dots together with silent intervals of different lengths, if desired, separating each group of dots and occurring at the beginning and end of each impulse section 28, 29 and 30. A change in length of the intervals serves to introduce additional secrecy.

Since a large number of the segments may be required it may be of advantage to provide a contact switch of considerable diameter so that each segment and its insulation will be of practical width or thickness. In Figures 6 and 7 no attempt has been made to ilustrate the complete number of segments per section as it is believed that the principles of the invention can be fully explained with a representative or limited number of segments. In the center of the circular contact member there is rotatably mounted an arm 32 to which is pivoted or otherwise secured a resilient contact member 33 trailing the arm and adapted to bear against the segments 26. The contact member 33 may be made of spring strip steel and at the point of contact is fairly sharp in order not to span more than one segment at a time. The arm 32 is adapted to be rotated at a uniform rate through bevel gearing 34 actuated through a shaft 35 by the motor 24. The latter is arranged to be energized as will be explained hereinafter when one of the frangible elements 7 (Figures 2, 3 and 4) has been fractured and the motor continues to operate until normal conditions have been restored or the ship has been sunk. As the arm 32 is caused to rotate, contact is successively made between the element 33 and each segment 26 and when any one or more of these segments are charged, preferably with audio frequency, an audio frequency impulse is applied to a transmitting radio set generally indicated at 37.

A system for charging the various segments in order to transmit an emergency message or messages is illustrated in Figure 7. As shown, wires 38 may be taken from the segments to terminals 39. Switches 40 are provided at the terminals, these switches being connected through conductors 41 to a common line 42 which passes into a single tone oscillator 43 of audio frequency. This oscillator may be of the usual electron tube type with feed back or resonant circuits of any suitable and well known character. It is apparent that when any one of the switches 40 are closed, the segment directly associated with that switch becomes charged with audio frequency and impulses are passed through the arm 32 to the transmitter 37 as the arm is rotated by the motor 24. The switches 40 are shown in diagrammatic form for the sake of clearness, but in practice they would be assembled on a switchboard with push buttons to make or break the circuits similar to a typewriter key board. Thus, any one or all of the connections between the segments and the oscillator may be made by pressing the proper keys and locking them in the depressed positions. These switches may be operated manually by an operator positioned near the switch apparatus or if desired and this will be explained hereinafter, the switches 40 may be remotely controlled from the bridge or other position of the ship through suitable mechanism by the navigator whenever the position of the ship has been determined or altered. Inasmuch as the section 28 of the circular switch is intended to convey the name of the ship which may not change over a long period of time permanent connections to the segments 26 of that section may be made to connote this information, so that switches may not be necessary.

If desired the length of the section 28 may be materially reduced in case the name of the ship is fairly short giving that much more space for the longitude and latitude sections 29, 30 which should be so finely divided so as to transmit to at least a second of longitude and latitude. Accordingly, when the switch arm 32 is rotated by the motor 24, impulses are impressed on the transmitter in a predetermined sequence which when translated at the receiving end in a suitable and well known manner would spell the name of the ship or any other desired information, then giving the longitude and then the latitude of the ship as set at the time that the switches 40 had been selectively operated.

Radio transmitting circuit and immediately associated apparatus

The transmitter 37 (Figure 6) may comprise a high frequency carrier oscillator and a tube modulator of suitable and well known type. The impulses which are impressed on the output lead 44 are fed to one of the input circuits of the modulator. The high frequency carrier is fed to another input circuit of the modulator and the output of the modulator is connected between an antenna 45 and ground 46.

Suitable sources of energy indicated diagrammatically by the grounded battery 47 may provide the necessary current for the carrier frequency and modulator tubes as is well known in the art. These tubes are preferably of the metal envelope and rugged indirectly heated type as is also the audio frequency oscillator tube 43. A source of energy 48 grounded at one end may provide the current for the last-mentioned oscillator.

It is apparent that the carrier frequency tube of the transmitter 37 would normally always be in operation to impress carrier frequency through the modulator tube onto the antenna 45 and that when impulses are transmitted to the modulator through the rotary switch and the line 44 this carrier frequency is modulated by the low frequency generated by the oscillator 43. Thus modulated carrier frequency waves are radiated from the antenna 45.

A simplified diagram of the transmitting circuit as pertaining to the structure shown in Figure 6 is illustrated in Figure 20. As shown, the low frequency source 43 connects through any one of the switches 40 to any one of the segments 26, then through the arm 32 to the modulator where it combines with the high frequency oscillations to be radiated by the antenna 45. In order to prevent the continuous radiation of high frequency from the antenna except when the modulating low frequency signals are being impressed thereon, a circuit 49 may be connected to the con-

trol circuit of the high frequency oscillator tube this circuit passing through a switch 50. The latter may consist of a stationary contact 51 and a swingable arm 52, with a projection 53 thereon which is adapted to contact with the switch arm 32 when the latter is in its vertical or stationary position. The circuit 49 is therefore opened during the time that the arm 32 is not moving which would be the normal condition unless an emergency arises. Thus the high frequency oscillator is rendered temporarily inoperative. As the arm 32 swings about the circular switch the circuit 49 is closed to permit oscillations, either modulated or unmodulated, to be radiated at the antenna 45.

The simplified circuit of Figure 20 shows the manner in which the switch 50 controls the operation of the carrier frequency oscillator.

It is apparent that the elements of the transmitter 37 and of the oscillator 43 are always ready for instant use so that when any one of the disruptive devices 7 is fractured by an explosion, causing the motor 24 to be operated, carrier waves modulated by low frequency impulses which have been selected by the charged segments 26 and the rotating arm 32 are immediately radiated from the antenna 45.

Inasmuch as the radio transmitter 37 and oscillator 43 must be on duty twenty-four hours a day, it may be desirable to provide a standby radio set, the cathodes of which are in an energized condition so that the standby radio set may immediately take up the burden when necessary. A suitable arrangement for carrying this out is shown in Figure 12 in diagrammatic form, the rectangle 54 representing all of the apparatus including tubes and circuits forming a complete transmitting set. All of the circuits of this set are energized by a source of current 55 through suitable switches 56. The standby radio set is indicated by the rectangle 57 which may be substituted for the set 54 by closing the switches 58 and opening switches 56. In case the tubes of the radio set are of the thoriated cathode type it may be desirable to substitute one set for the other at stated periods throughout the twenty-four hour period in order that the cathodes may be rejuvenated or inspections made.

As stated hereinbefore, the high frequency carrier tubes of the transmitter sets 37 (Figure 6) which are positioned in the respective sections A, B, C (Figure 1) are adapted to generate different frequencies for propagation at the respective antennae 5. These frequencies should be separated from one another in the frequency spectrum sufficiently that neither the basic frequencies nor any of their side bands overlap. Crystal controlled oscillators serve this purpose admirably. Thus there is transmitted from the antennae 5 (Figure 1) as many different carrier frequencies modulated by low frequency impulses of a predetermined character as there are antennae and the fact that more than one carrier frequency is employed enhances the chances of at least one of the messages reaching friendly ships. The order of magnitude of these frequencies will depend on the distance that is required to be reached, the power available and the size of the ship, keeping in mind that carriers of the usual broadcast range frequently have great reliability of transmission while carriers of ultra high frequency, the so-called short wave, have less reliability but are adapted to transmit greater distances for a given amount of expended energy.

In order still further to increase the reliability of operation it is desirable that all parts of each radio set including the circular contact switch 6, all of the tube elements, sources of energy and the motor 24 be contained in a hermetically sealed casing with provisions made to effect changes in the position of the switches 40 at will.

Testing apparatus for the impulse transmitter

It may be desirable from time to time to test the transmission of the impulse modulated carrier from the individual antenna 5 in order to assure that the set is in perfect working condition at all times. For this purpose a separate test circuit is employed, this circuit being illustrated in Figures 1 and 6. A manually controlled switch 59 is inserted within the common energizing circuit for each of the protective circuits which are scattered throughout the ship, this switch being so arranged that it has the same effect insofar as starting the operation of each transmitter is concerned as if any one or all of the frangible elements 7 have been broken. Thus by opening the switch 59, the motors 24 in the sections A, B, C (Figure 1) are immediately energized through their respective electromagnets 15, 16, 17, 18, 18', 19 and 20 in order to impress low frequency code signals on the respective modulating tubes. These electromagnets have been representatively illustrated in Figure 6 by a single electromagnet 60, the latter being shown in connection with a single pole switch for clarity.

It is apparent that when the switch 59 is opened and assuming that the rotary switch 6 is concealed in a casing, it would be difficult if not impossible to know when to close the switch 59 at the instant that the arm 32 has reached its zero or vertical position at the end of the test. Suitable structure must therefore be provided to bring the arm 32 to its vertical position after each testing period. A convenient way of accomplishing this is to provide a pair of spaced circular conductors 61, 62 over which a bridging contact 63 may be moved, this contact being secured to the arm 32. The conductors 61, 62 are connected through leads 64 to the motor 24 as a parallel circuit with respect to the battery 23. Thus when the arm 32 has been moved from its vertical or neutral position after having opened switch 59 (Figure 1) a circuit will be established through the motor until the arm will have made a complete turn and the contact member 63 rests on an insulating element 65. The arm 32 is therefore assured of coming to rest at its vertical or neutral position regardless of when the test switch 59 is closed and which action normally would open the motor circuit if it were not for the auxiliary holding circuit through the conductors 61, 62.

Remote control of the charging of the segments which form the rotary switch

It is evident that in the system illustrated in Figures 1, 6 and 7, an operator may be stationed near the separate banks of switches 40 in each of the sections A, B, C and would obtain his instructions for operating these switches by telephone from the bridge. However, in order to eliminate the necessity for employing a number of operators whose duty is to take care of the switching operations in the various parts of the ship, a remote control apparatus may be employed to advantage for performing these operations directly by the navigator.

An indexing apparatus provided with mech-

anism for opening or closing any or all of the switches 40 may be provided at each of the separate transmitting sets and the control circuits therefor may be taken to the bridge. These circuits are shown more particularly in Figure 8 and the details of the indexing, setting and resetting apparatus are illustrated in Figures 9, 10, 11, 14 to 18 inclusive. It will be understood that the term "setting device" designated on the drawing includes all of the elements of the indexing wheel or spider, also the setting and resetting apparatus. The setting device may be positioned at any suitable distance away from the rotating arm switch 6 and consists essentially of an indexing mechanism which may be controlled from a remote position. This mechanism includes a spider 67 (Figure 14) carrying a pair of setting and resetting solenoids which may also be remotely controlled.

The function of the solenoids is to charge or discharge any or all of the segments 26 of the circular contact switch 6. The spider 67 may be formed of a flat arm and is rotatably supported on bearings (not shown). Depending downwardly from the arm or spider 67 there is a bracket 69 in which is slidably mounted a shaft 70. This shaft carries an armature 71 made up of soft iron laminations and forming the rotor of a bipole motor 72. The frame of the latter is secured to the spider 67 and is provided with a pair of field coils 73, the arrangement being such that when these coils are energized the poles of the armature 71 are attracted to cause the shaft 70 to rotate through 90°. Upon these coils being de-energized, the shaft is brought back to its original position by means of a torsional spring 74.

At the end of the shaft 70 opposite from the motor 72 there is provided a solenoid 75 containing a reciprocable armature 76 which is carried on the shaft and is adapted to move into the solenoid, i. e., to the right, as seen in Figure 14 when the solenoid is energized in a manner which will be described presently. There is a compression spring 77 interposed between the armature 76 and the bracket 69 to restore the shaft to its left hand position (Figure 14) when the solenoid is de-energized. Thus the shaft 70 is adapted to be rotated through 90° and can also be shifted from its left hand to its right hand position when solenoid 75 is energized. The extreme ends of the shaft 70 carry a pawl holder 78 of quadrant configuration as shown in Figure 18. A pair of rectangularly shaped pawls 79, 80 extend outwardly from the pawl holder and are secured to the latter. These pawls are beveled in such a manner that the bevel of one pawl is displaced 90° from the bevel of its companion pawl; the purpose for this will be clear when the operation is described. A pair of stops 81 may be secured to the underside surface of the spider arm, these stops being so positioned as to allow the pawl holder 78 to move through 90° clockwise or counterclockwise as seen in Figure 18. The pawls 79, 80 are adapted selectively to engage teeth 83 formed on the interior surface of a stationary rack 84 which for convenience has a circular configuration.

The overall length of the shaft 70 including the outermost distance between the two sets of pawl pairs 79, 80 is slightly less than the distance between the innermost faces or edges of the teeth 83. The shape of these teeth and the angle of the bevel on the pawls 79, 80 are such that when the shaft 70 is caused to move to the right (Figure 14) upon energization of the solenoid 75 one of the pawls 79, 80 is caused to enter the space between the teeth of the rack and thus give an indexing motion to the spider 67. This condition is shown in Figure 10 and a comparison of Figures 9 and 10 indicates that the spider has moved through a limited angle in the counterclockwise direction. One the other hand, when the motor 72 is energized as well as the solenoid 75 so as to rotate the quadrant 78 clockwise (Figure 18) and to move the shaft 70 to the right the pawl opposite from that which had previously engaged the teeth 83 will now engage the teeth to index the spider 67 in the opposite direction. The solenoid 75 is energized by a series of impulses, i. e., intermittently, and during the time between impulses when the solenoid is de-energized the compression spring 77 will cause the shaft 70 to move to the left so that the pawl 79 or 80 at the left hand end of the shaft (Figure 14) will engage the teeth 83 thus to complete the indexing movement of the spider 67. This is the condition shown in Figure 11 and a comparison of Figures 10 and 11 indicates that the spider had moved through an additional angle counterclockwise in continuation of its immediately preceding movement.

The latter is therefore adapted to be rotated step by step in either the clockwise or counterclockwise direction by means of the solenoid 75 and the direction of movement depends upon whether or not the motor 72 has been energized to reverse the positions of the pawls 79, 80. The indexing apparatus described above may be made very rugged by enclosing the shaft and its immediately associated apparatus within a cylinder 85, closed at the lower end and in which the teeth 83 are formed as a flanged ring extending inwardly from the upper or open end of the cylinder. It will be understood that if desired these teeth may project outwardly from the cylinder when suitable changes are made with regard to the pawl mechanism 78, 79, 80. The arm 67 carries at one end an upwardly extending casing 86 having openings 87 in its top plate which slidably receive rods 88. These rods, of which there are two are connected with the armatures 89 of solenoids 90, 91. The arrangement is such that when either of these two solenoids is energized the armature 89 of that solenoid is caused to move downwardly.

A compression spring 92 may be inserted between the top plate of the casing 86 and a collar 93 carried on the rod 88, the purpose of this spring being to pull the armature 89 upwardly when its solenoid has been de-energized. The armatures 89 are provided at the lower ends with rods 94, 95 terminating in bifurcated yokes 96. Beveled wheels or rollers 97 are rotatably mounted within these yokes as can be seen in Figure 17. Directly below the wheels 97 there is a stationary bracket 98 on which is swivelly mounted as indicated at 99 a bar 100 beveled at one or both ends as indicated at 101. This bar has a downwardly depending portion constituted of an insulating section 102 and a metal section 103. Directly opposite the portion 103 there is a spring clip 104 insulatingly mounted on an upright 105. The portions of the clip are insulated from one another by means of a block 106 of any suitable insulating material. Conductors 107, 108 are taken from the individual spring clip portions 104, conductor 107 being connected to its individual segment 26 and conductor 108 may be connected to the output of a low frequency oscillator. It is apparent that when for example the solenoid 91 (Figure 14) is energized the rod or plunger 95 is

moved downwardly as explained hereinbefore to rotate the T shaped member 100, 103 clockwise and to cause the conducting portion 103 to enter the spring clip 104 and thus to make a circuit between conductors 107 and 108. This is the condition shown in Figure 14.

On the other hand, when the solenoid 90 (Figure 14) is energized the T shaped member will be rotated counterclockwise to break the circuit between the conductors 107 and 108. It will be understood that there are as many clips 104 and T shaped members provided as there are segments 26 and these elements may be supported from a plate in a circular arrangement so that as the spider arm 67 is rotated and one or the other of the solenoids 90, 91 is energized any one or all of the many circuits represented by the conductors 107, 108 may be either opened or closed. In view of the fact that the spider arm 67 may be rotated in either direction depending on the condition of the motor 72 individual switching effects may be obtained at any point throughout the circular array of switches and a single switching operation may be performed without interfering with the condition of the remaining switches. For convenience, the solenoid 91 will be designated as the setting apparatus since it serves to apply low frequency to that segment 26 with which the switch 104 upon closure is associated. Solenoid 90 will be designated the resetting apparatus in that it serves to open any one of the circuits at 104 and thus to prevent the application of low frequency currents to that segment with which the open switch 104 is associated. Current may be supplied to the solenoids 90, 91, the motor 72 and the solenoid 75 in any convenient manner, for example by means of the slip rings shown in Figure 14.

The purpose of the rollers 97 operating in conjunction with the beveled surface 101 is to reduce friction at the time that any change is being made in the position of the T shaped member. It is apparent that all of the switches may be either opened or closed as the spider is indexed by simply maintaining the resetting solenoid 90 or the setting solenoid 91 in an energized condition.

Remote control apparatus for the setting and resetting mechanism

Figure 8 shows the general arrangement of the setting devices with respect to the rotatable contact switches and the individual radio sets together with circuits by which the setting devices may be controlled from a remote position, specifically the bridge of a ship. Three setting devices are illustrated by way of example and these devices are preferably positioned in the various parts of the ship, sections A, B, and C (Figure 1) and each setting device and its immediately associated radio set including the low frequency oscillator are energized by an individual source of energy typified as a relatively high voltage generator 109. These generators may be driven by a relatively low voltage motor 110 at each position which in turn is supplied with current obtained from a low voltage generator 111. The latter may be actuated by a motor 112 which obtains its energy from the ship's supply mains. In order to assure a supply of current for operating the motors 110 in case the ship's main generator is destroyed, I may provide storage batteries 113 across the circuit leading to the motors 110 and interpose a suitable form of current limiting device 114 in the storage battery circuit to prevent overcharging. Whenever the supply of current from the generator 111 is cut off for any reason, the fully charged storage battery 113 which up to this time had merely floated across the line now constitutes the source of current by which to operate the low voltage motor 110. The storage batteries are obviously contained in a suitable water-tight receptacle and protected as far as possible from the effects of explosion.

While in Figure 8 I have shown a complete electrical circuit 115 connected between the generator 109 and the high frequency oscillator 2 it will be understood similar circuits are also taken to any other part of the transmitter set or to any part of the impulse selecting device including the setting apparatus that may be necessary. It will be noted in Figure 8 that the impulse selecting device is connected in the antenna circuit between each antenna 5 and its modulator 4. This is a somewhat different circuit than is shown in Figure 6 in that when the arm 32 (Figure 6) of the impulse selecting device is at its upper or neutral position the antenna circuit is interrupted and no carrier, either modulated or unmodulated is transmitted. The necessity for the switch 50 shown in Figure 6 is therefore eliminated under these circumstances. Figure 19 shows the essentials of the circuit employed in Figures 1 and 8, and it will be noted that all of the selector switches 40 or 104, also the rotary switch 6 are in the antenna circuit.

The mechanism for controlling the setting devices is shown at the upper right hand corner of Figure 8. This mechanism includes three key switches 116, 117 and 118 of the "momentary depress" type which have been labeled "reset," "set" and "index" respectively. In addition there is a "reverse" switch 119 which may be in the form of a knife switch. A convenient circuit is taken from ground 120 through a pair of batteries 121 connected in parallel through the reset switch 116, conductor 122 to the reset solenoid 90 of each setting device (see Figure 14). A corresponding circuit may be taken from the battery 121 through the set switch 117, the conductor 123 to the set solenoid 91 of each setting device. The circuit for the reversing switch is taken from the battery 121 through switch 119 through lead 124 to the reversing motor 72 of each setting device. Finally a circuit is taken from the battery 121 through the indexing switch 118 through lead 125 to the solenoid 75 of each setting device. The index, reverse, set and reset switches may be contained in a box positioned on the bridge of the ship leaving exposed merely the handles by which the switches may be operated and within reach of the navigator. Whenever it is desired to change the connection of the impulses which would be set out by the antennae 5 under an emergency, the officer would periodically depress the index key 118 which would move the spider 67 of the setting device in a predetermined direction.

When the spider arm is indexed in accordance with the movements of the key 118 the setting switch 117 is depressed in a predetermined manner in order to cause the metal section 103 (Figure 17) to enter the spring clip 104 at the position to which the spider has momentarily moved. Thus the index key 118 is depressed periodically until the spider 67 has made a complete revolution, and from time to time the setting key 117 is depressed to cause a connection between the predetermined segments 26 and the source of low frequency current 3. If the officer desires to

make a change as to the movement or position of the contacts 103 (Figure 7) which have been caused to enter their respective clips 104 it is merely necessary to close the reversing switch 119 whereupon movement of the indexing key 118 will cause movement of the spider to reverse. When the latter has reached the selector switch 103, 104 in which a change in condition becomes necessary, the reset switch 116 is then operated which causes the metal section 103 to be withdrawn from its spring clip 104. Upon opening the reversing switch 119 and periodically depressing the indexing switch 118 the spider arm 67 will continue movement in its original direction.

It is therefore apparent that I have disclosed a convenient and simplified method and apparatus for operating the setting device including the closure of the contacts 103, 104 by means of switches which may be positioned remote from the setting devices. The switch arrangement is such that the setting and resetting circuits are entirely separate from one another so that confusion as to the exact operation taking place at the remotely positioned setting devices is reduced to a minimum. These switches may be operated at stated time intervals, the shorter the better in order to keep the adjustments of the impulse selecting device abreast of the changes in position, longitude and latitude of the ship. As stated hereinbefore, when any one of the frangible devices 7 is disrupted the motor 24 of one or more impulse selecting devices 6 is immediately energized to complete a circuit between the antenna 5 and the modulator to ground so that high frequency impulses are radiated, the character of which is controlled by the last adjustment of the setting device.

In order to distinguish at the receiver between the impulse groups connoting the name of the ship, the latitude and longitude, I may employ a 3-tone oscillator for the audio frequency and arrange the circuits in such a manner that as the arm 32 is moving over the section 28, tone No. 1 is impressed on the modulator. Likewise when the arm 32 is moving over sections 29 and 30 of the rotary switch (Figure 6) tone No. 2 and tone No. 3 respectively are applied to the modulator. This effect is diagrammatically illustrated in Figure 13. It will be understood that the switches 126 shown in this figure may be manually controlled as was explained in connection with Figure 7 or may be automatically and remotely controlled as was explained in connection with Figures 8, 14 to 18 inclusive. The 3-tone oscillator 127 (Figure 13) may comprise three separate tubes and the frequencies generated by these tubes may represent a distinct difference in pitch so that a listener would readily differentiate between the detected groups of impulses on the tone basis and would know as to whether that particular group pertains to longitude or latitude. In other words, the 3-tone oscillator serves to break up the impulse signals into groups of different tones which may be readily detected by a listener as following a predetermined plan.

While I have described the invention on the basis of transmitting a plurality of dots separated by variable silence intervals, it will be understood that when suitable and well known changes are made in the character of the rotary arm switch 6 dashes could also be transmitted in order to increase the etymological range of the transmitted message. It is also apparent that instead of applying low frequency impulses to a radio set for transmission purposes I may employ these impulses or any other form of impulse to send out light signals similar to a blinker system when an emergency arises. These low frequency impulses as selected by the setting device may also be made to operate a supersonic transmitter which radiates messages according to the selected impulses through the medium of the water or atmosphere. In fact various other forms of signaling will present themselves to those skilled in the art as being particularly applicable to the disclosed method and apparatus of setting the desired message on an electrical device and have this message immediately and automatically transmitted when critical damage is sustained by the ship.

It will readily occur to those skilled in the art that instead of providing an index key on the bridge to operate the remotely positioned indexing mechanism in each section of the ship a pointer and dial arrangement may be used to advantage. Any suitable form of coupling as will insure synchronous movement between the pointer and the indexing arm might be used, mechanical or electrical such as shafting and gears, pulleys and flexible cables contained in protective sheathing or synchronous motors.

It will be understood that I desire to comprehend within my invention such modifications as come within the scope of the claims and the invention.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An emergency radio transmitting system for ships comprising a circular multi-contact device, a switch arm adapted to rotate over said contacts and successively to make connection therewith, the contacts on said device being arranged in groups of which one group provides impulses concerning the longitude of the ship and another group provides impulses concerning the latitude of the ship, each group of impulses having different identifying tones, and means for automatically applying said impulses immediately when an emergency arises to a radio transmitting system, said means comprising a circuit containing a readily frangible conducting element which when broken permits transmission of the impulses to the radio system.

2. A radio transmitting system for ships, said system comprising a plurality of radio transmitting sets with individual antenna, said sets including carrier frequency oscillators which are tuned to different frequencies as between the different sets, means for modulating the carrier frequencies by impulses which represent a message concerning the location of the ship, means for rendering inoperative each transmitter set only so long as no substantial damage has been sustained by the ship.

3. A radio transmitting system for ships, said system comprising a plurality of radio transmitting sets with individual antenna, said sets including carrier frequency oscillators which are tuned to different frequencies as between the different sets, means for modulating the carrier frequencies by impulses which represent a message concerning the location of the ship, means for rendering inoperative each transmitter set only so long as no substantial damage has been sustained by the ship, said means including closed circuits distributed throughout the ship and including frangible current conducting elements, said elements being adapted when ruptured during the sustainment of damage by the ship imme-

diately to cause energization of one or more radio sets to transmit said message.

4. A radio transmitting system for ships, said system comprising a plurality of radio transmitting sets with individual antenna, said sets including carrier frequency oscillators which are tuned to different frequencies as between the different sets, means for modulating the carrier frequencies by impulses which represent a message concerning the location of the ship, means for rendering inoperative each transmitter set only so long as no substantial damage has been sustained by the ship, said radio sets being positioned at different locations throughout the ship and said means comprising current conducting frangible elements distributed throughout the critical areas of the ship and so connected with the energization circuits of the radio sets that the fracture of any one of said elements would cause the immediate energization of the radio sets located remote from that element.

5. A distress signaling system for ships including a plurality of complete radio sets and separate antennae, said sets being positioned in a protected portion of the ship and distributed throughout the ship, at least one in the bow portion, another in the stern portion and at least a third set in the midship portion, each of said sets being adapted to transmit modulated carrier waves tuned to frequencies which do not interfere, means for pre-setting the code message to be transmitted according to the geographic location of the ship by each of said sets and means for preventing the operation of each set until an emergency arises, said last-mentioned means comprising at least one frangible current conducting element positioned in the bow of the ship which prevents operation of the midship and stern portion sets, also including a current conducting frangible element in the midship portion which prevents operation of the bow and stern portion sets and also including at least one frangible current conducting element in the stern which prevents the bow and midship radio sets from operating whereby when any one of said frangible elements are ruptured during the sustainment of damage by the ship the radio sets associated with that element will immediately and automatically set into operation to transmit the predetermined message.

6. A distress signaling system for ships including a plurality of complete radio sets and separate antennae, said sets being positioned in a protected portion of the ship and distributed throughout the ship, at least one in the bow portion, another in the stern portion and at least a third set in the midship portion, each of said sets being adapted to transmit modulated carrier waves tuned to frequencies which do not interfere, means for pre-setting the code message to be transmitted by each of said sets and means for preventing the operation of each set until an emergency arises, said last-mentioned means comprising at least one frangible current conducting element positioned in the bow of the ship which prevents operation of the mid-ship and stern portion sets, also including a current conducting frangible element in the mid-ship portion which prevents operation of the bow and stern portion sets and also including at least one frangible current conducting element in the stern which prevents the bow and mid-ship radio sets from operating whereby when any one of said frangible elements are ruptured during the sustainment of damage by the ship the radio sets associated with that element will immediately and automatically set into operation to transmit the predetermined message, and structure by which said pre-setting means can be accomplished from the bridge of the ship to change the message in accordance with changes in the position of the ship.

7. A distress signaling system for a ship comprising a plurality of complete radio sets positioned in different sections of the ship, said sets being adapted when rendered operative to transmit pre-set messages giving the location of the ship means for rendering the sets normally inoperative, said means comprising a plurality of current conducting frangible elements, at least one of which is associated with each set, each element being positioned within the ship remote from the radio set with which it is associated whereby when said element is fractured its associated radio set automatically becomes operative to transmit the predetermined message.

8. A radio transmitting system for ships, said system comprising a plurality of radio transmitting sets with individual antenna, said sets including carrier frequency oscillators which are tuned to different frequencies as between the different sets, means for modulating the carrier frequencies by impulses which represent a message concerning the location of the ship, means for rendering inoperative each transmitter set until substantial damage has been sustained by the ship, said means including a normally closed circuit which is opened by the force of the explosion causing said damage and which circuit puts the transmitter set into operation.

9. A remotely controlled impulse signaling device comprising a contact arm adapted to move over a plurality of contacts and a switch selector including a plurality of switch members for charging said contacts, said switch selector also being provided with a rotary element, solenoid means for rotating said element and solenoid means carried on said element for setting or resetting the switch members of the selector switch in a predetermined manner as said element is rotated, means for controlling each of said solenoid means from a position remote from the signaling device, and means including a rupture susceptible device for normally preventing movement of the contact arm until a damage producing explosion occurs whereby said device is caused to propagate signals in accordance with the preset of the selector switch.

10. A radio system comprising a plurality of radio sets having individual antennae and sources of carrier of different frequencies connected to said antennae, a plurality of sources of low but different frequencies associated with each carrier, means for applying said sources of low frequency in succession to their respective carriers through modulating devices, standby sources of carrier, low frequency and modulating devices at each radio set, means for selecting the source of the carrier and low frequency, also the modulating device which are to be used in the transmission of intelligence-conveying impulses, means including the antennae for broadcasting the impulse output of said modulating device which is temporarily in use, and means for automatically initiating operation of said radio sets by the forces of explosion or other damage occurring in the immediate vicinity of the radio sets.

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