

Dec. 6, 1938.

I. F. DURST ET AL
PUBLIC ADDRESS SYSTEM

2,139,006

Filed May 28, 1936

5 Sheets-Sheet 1

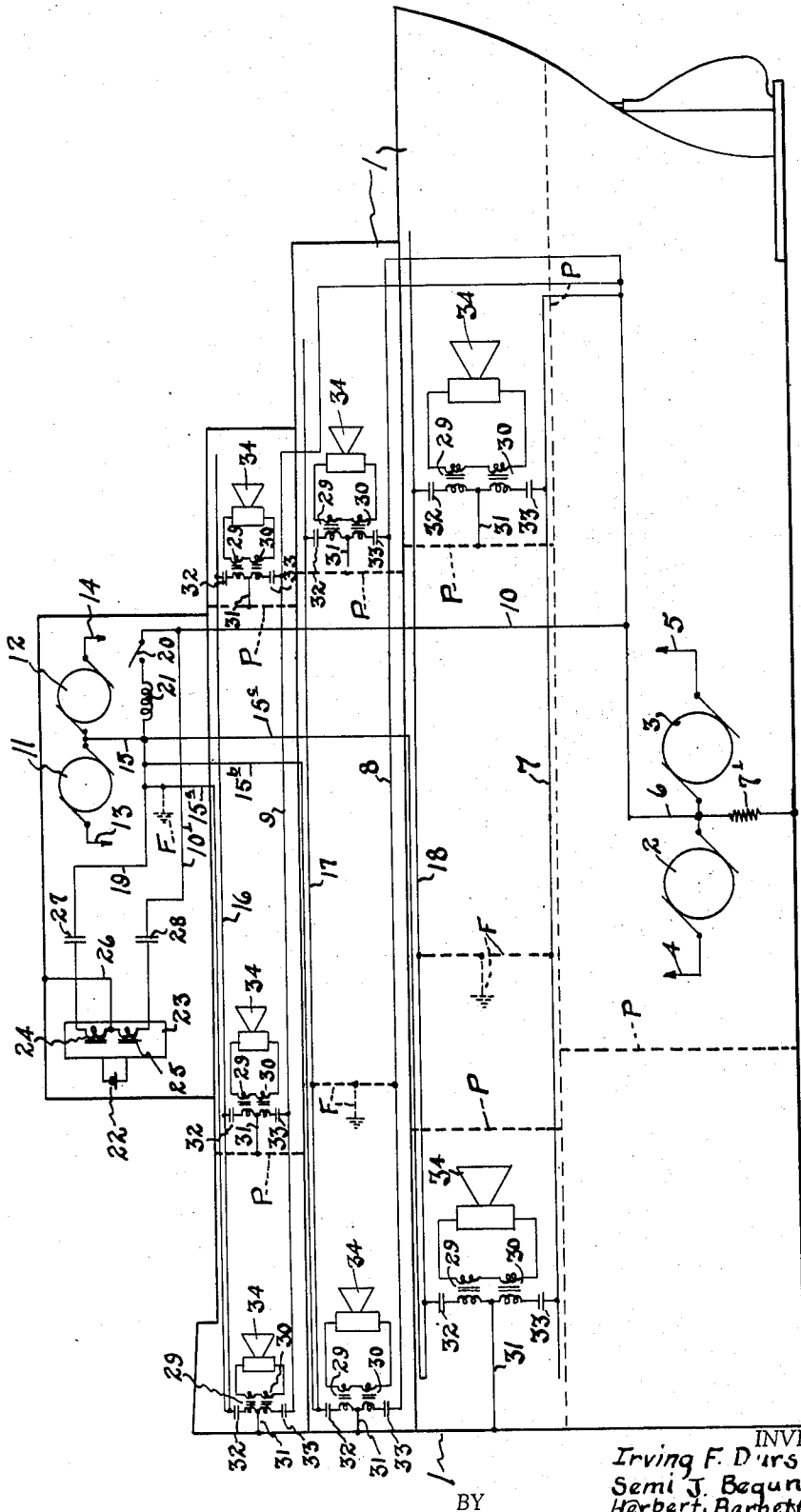


Fig. 1.

INVENTOR.
Irving F. Durst
Semi J. Begun
Herbert Barnett
Darby & Darby
ATTORNEYS.

Dec. 6, 1938.

I. F. DURST ET AL
PUBLIC ADDRESS SYSTEM

2,139,006

Filed May 28, 1936

5 Sheets-Sheet 2

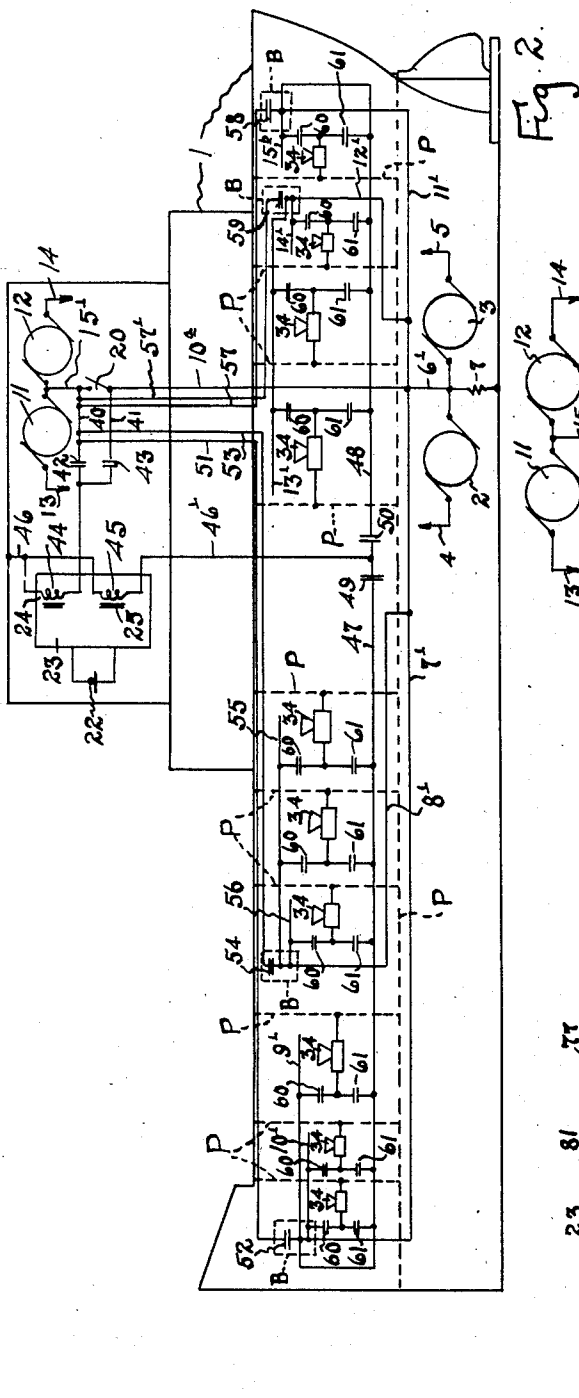


Fig. 2

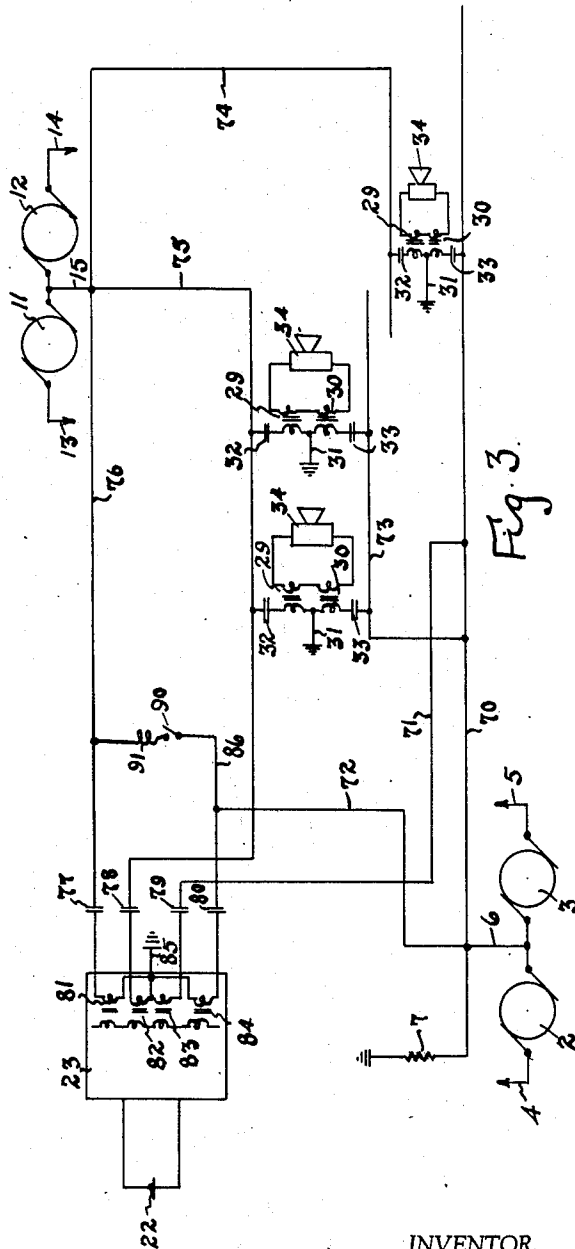


Fig. 3

BY

INVENTOR.
Irving F. Durst
Semi J. Begun
Herbert Barnett
Durst & Waukey
ATTORNEYS.

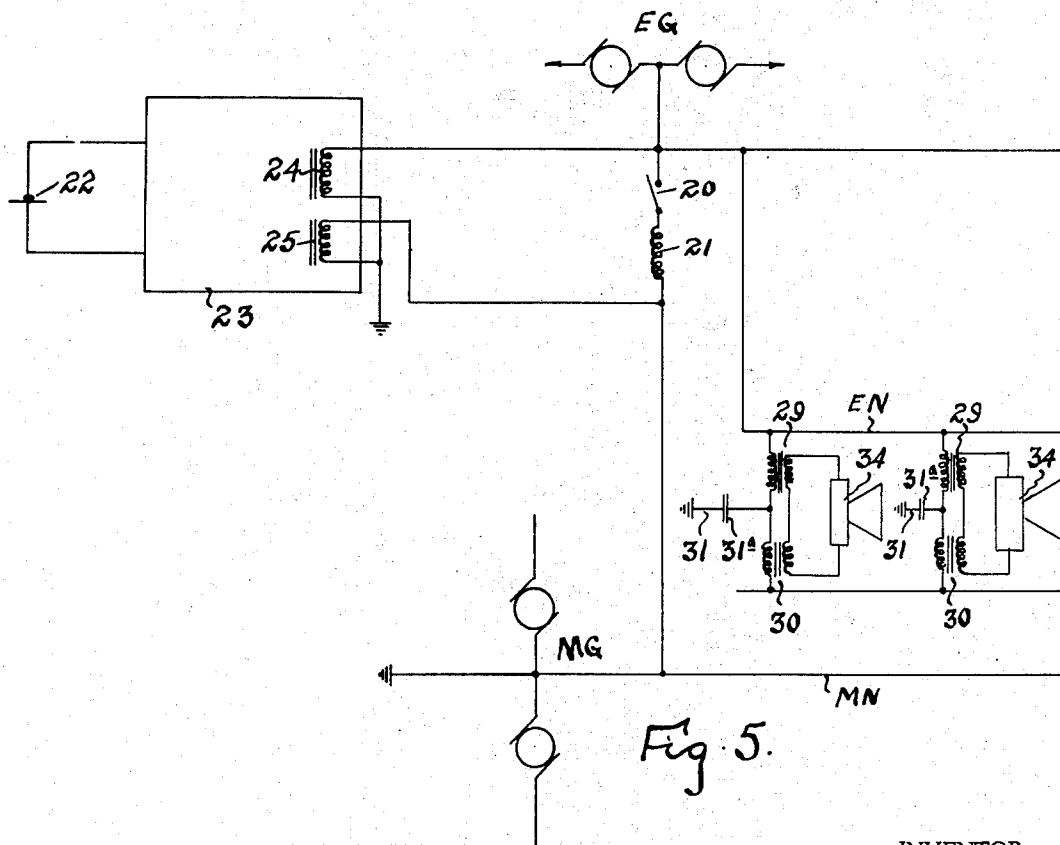
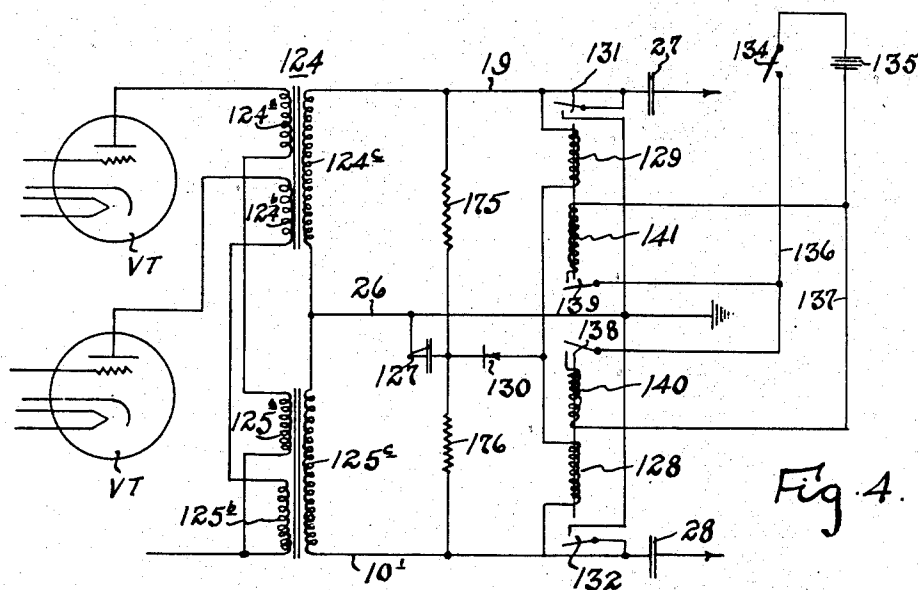
Dec. 6, 1938.

I. F. DURST ET AL
PUBLIC ADDRESS SYSTEM

2,139,006

Filed May 28, 1936

5 Sheets-Sheet 3



INVENTOR.
Irving F. Durst
Semi J. Begun
Herbert Barnett
Durst & Durst
ATTORNEYS.

BY

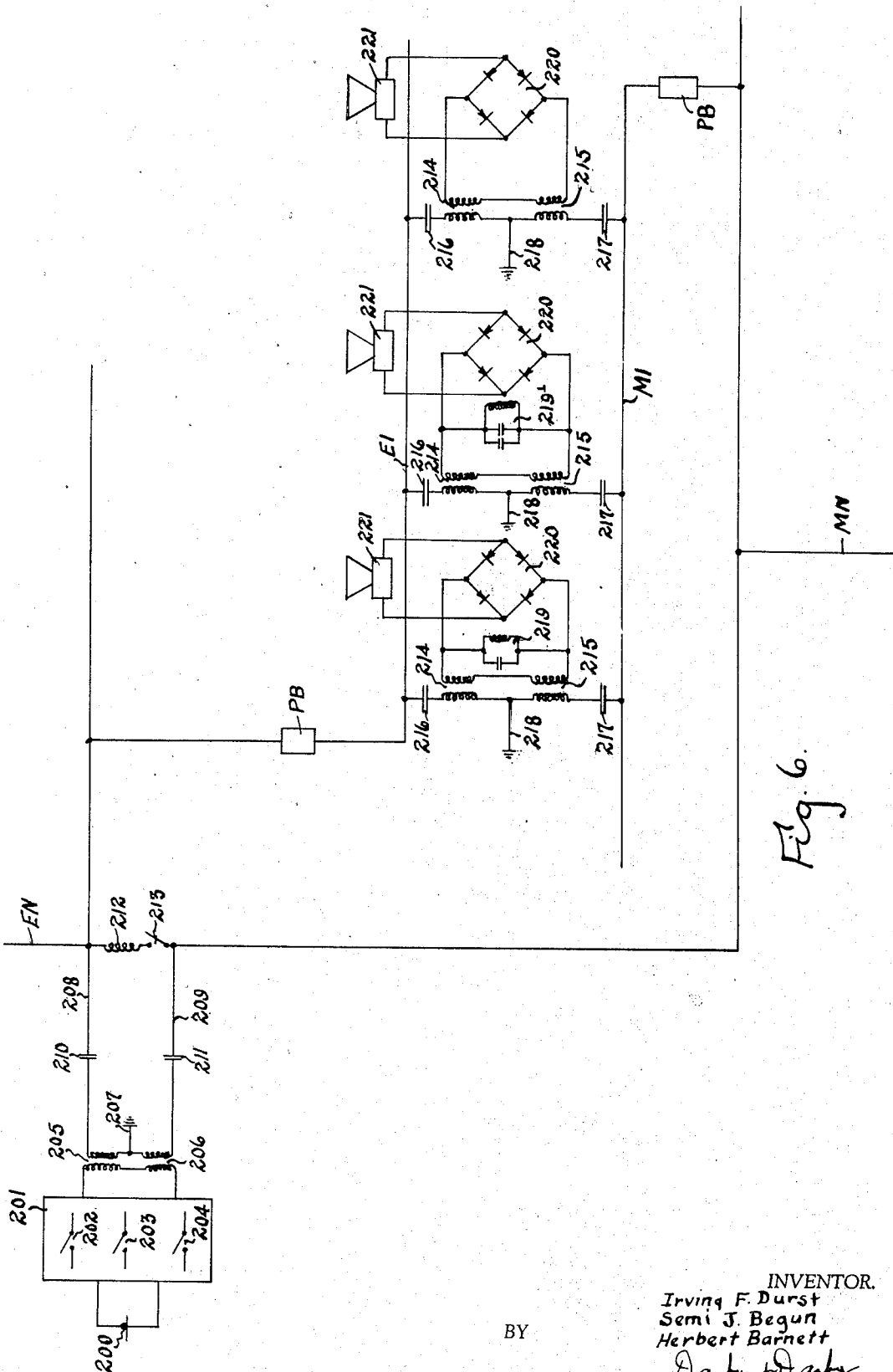
Dec. 6, 1938.

I. F. DURST ET AL
PUBLIC ADDRESS SYSTEM

2,139,006

Filed May 28, 1936

5 Sheets-Sheet 4.



Dec. 6, 1938.

I. F. DURST ET AL
PUBLIC ADDRESS SYSTEM

2,139,006

Filed May 28, 1936

5 Sheets-Sheet 5

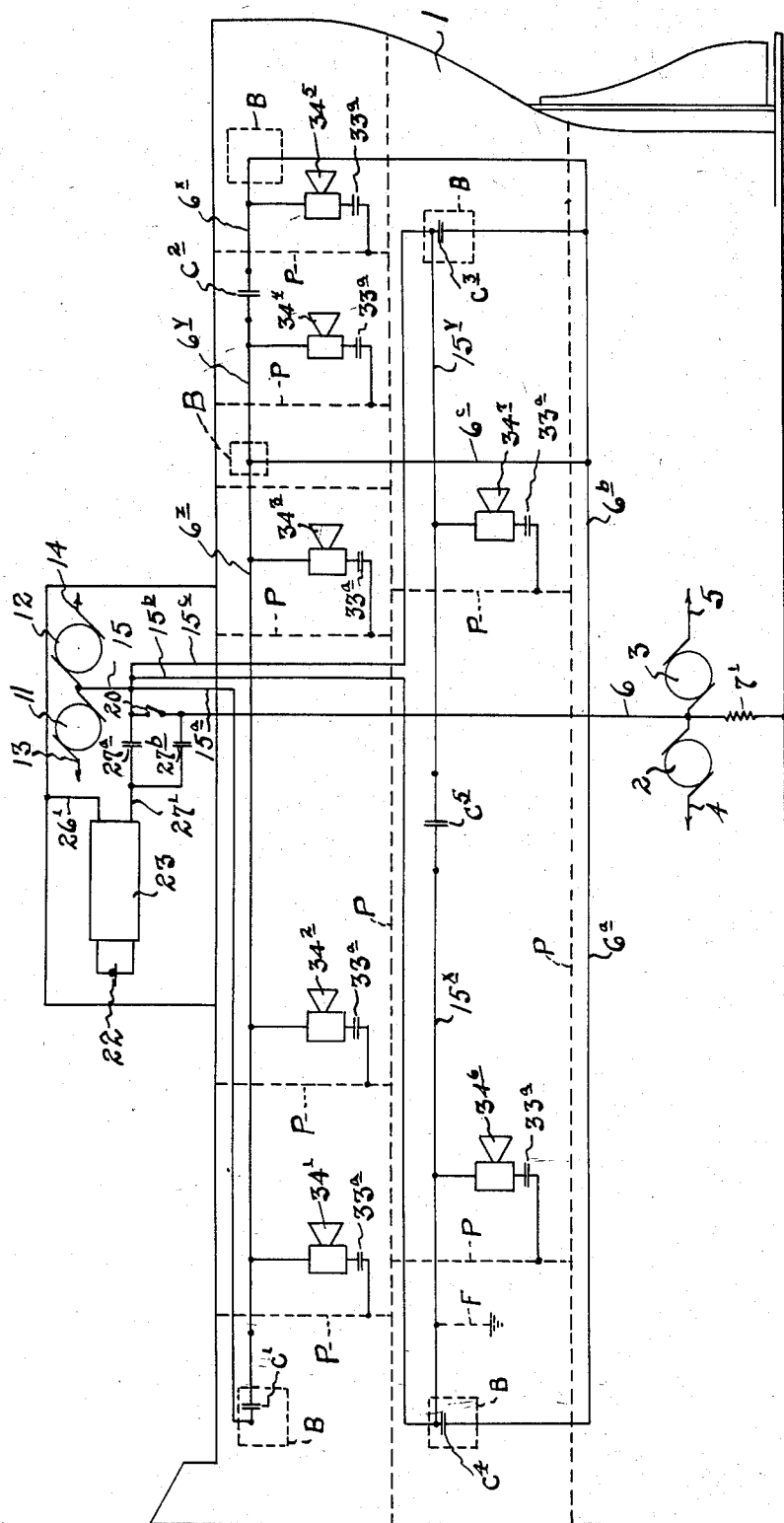


Fig. 7.

INVENTOR.
Irving F. Durst
Semi J. Begun
Herbert Barnett
Daly & Daly
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,139,006

PUBLIC ADDRESS SYSTEM

Irving F. Durst, Great Neck, and Semi Joseph Begun and Herbert Barnett, New York, N. Y., assignors, by mesne assignments, to Carll Tucker, New York, N. Y.

Application May 28, 1936, Serial No. 82,244

25 Claims. (Cl. 179—2)

This invention relates to improvements in signaling systems of the type commonly known as public address systems, with particular relation to the application of such systems to shipboard.

5 The basic object of this invention is to provide a public address system for use on board ship having circuit characteristics which greatly increase the dependability of the system both under normal and emergency conditions.

10 More specifically the invention consists in the application of a signaling or public address system to a conductive network comprising the three-wire neutrals and the normal and emergency wiring circuits commonly employed on shipboard to provide a plurality of channels over each of which the signal energy may be transmitted to operate signal responsive devices common to all the channels.

15 A still further object of the invention is to incorporate the signal responsive devices in a system of this type whereby the grounding or short circuiting of portions of the system or of some of the signal responsive devices does not operate to render the remainder of the system and the remainder of the signal responsive devices inoperative.

20 These and many other objects as will appear from the following disclosure are secured by means of this invention:

30 This invention resides substantially in the combination, construction, arrangement, and relative location of parts, all as will be set forth in the necessary detail in the following specification.

35 In the accompanying drawings,

Figure 1 is a diagrammatic view of one form of system in accordance with this invention as applied on board ship;

40 Figure 2 is a similar view of a modified arrangement particularly with respect to the connection of the signal responsive devices to the multi-channel network;

45 Figure 3 is a diagrammatic modification of the arrangement of Figure 1 somewhat simplified;

Figure 4 is a diagrammatic layout of a modification of a portion of the system for employing automatic means for switching any impedance in the coupling transformer circuits in case of an open circuit on one of the lines;

50 Figure 5 is a diagrammatic illustration of a portion of the system in accordance with this invention especially designed for use on alternating current power systems;

55 Figure 6 is a diagrammatic illustration of a

carrier frequency system employing the principles of this invention; and

Figure 7 is a diagrammatic illustration of a further modified form of system employing the principles of this invention.

5 In the cause of safe and dependable operation of ships at sea, and particularly in emergencies, it is highly desirable to provide a signaling system by means of which the officers on the bridge or at other control points on a vessel be able to issue orders to the entire ship, that is to the crew and passengers, or to either selectively, or to selective groups thereof. Any such system applied on shipboard finds its maximum utility at times of emergency only if the signaling system 15 is so constructed and installed that in times of emergency it may be depended upon to function normally. It is believed that heretofore no such system has been available.

20 The normal signaling or public address systems employed on land are particularly vulnerable under emergency conditions, and are not at all adapted to use on shipboard. Wiring circuits on board ship even under normal conditions are notoriously subject to undesired grounds 25 and short circuits of a nature which would render the ordinary signaling systems if not inoperative, highly uncertain. Likewise, in cases of emergency on shipboard the ordinary signaling system which provides but a single transmitting 30 channel is particularly vulnerable to complete inoperability because of the possibility of the interruption of the circuits.

35 The system of this invention is characterized by unusual dependability not only under normal, but also under the most adverse emergency conditions because it is characterized first by the fact that it comprises a plurality of channels over any one of which the signal energy may travel to the signal responsive devices in spite 40 of interruption of the other channels, and secondly because undesired grounds and short circuits and defective signal responsive devices do not render the other signal responsive devices inoperative. These broad features will become apparent in several specific applications from the following description.

45 In Figure 1 a portion of a ship's hull and superstructure is diagrammatically illustrated at 1. Modern sailing vessels are commonly equipped 50 with two power supply sources which may be termed the normal and emergency sources for supplying electric energy for the operation of the electrical equipment carried by the vessel. At 2 and 3 are diagrammatically illustrated genera- 55

tors which are connected to supply a three-wire system comprising the circuit wires 4 and 5 and the neutral 6. For purposes of simplicity the circuit wires 4 and 5 have not been shown extended to various parts of the vessel since they are not involved in this invention. Neutral 6 is shown grounded to the hull of the vessel through a resistance 7' which is commonly present in the grounding connection. The neutral 6 is shown running on one deck level to the various parts of the ship by the wire 7. Similarly this neutral is shown extending to the various parts of the ship on the other deck levels, as indicated at 8 and 9. These neutrals are connected as shown to the common neutral wire 6.

On the bridge or at some other suitable point on the upper deck of the ship, as is common practice, are the emergency generators 11 and 12 which are provided with their own wiring system independent of the wiring system fed by the generators 2 and 3. The emergency wiring system comprises conductors 13 and 14 which as before are not shown extended to the various parts of the ship, and a common neutral 15. This neutral is provided with the branch neutrals 16, 17 and 18 at the various deck levels, and connected thereto by the leads 15^a, 15^b and 15^c respectively. As is common practice, on shipboard, the neutrals 6 and 15 may be connected together. This has been indicated by the wire 10 and the switch 20. In accordance with this invention there is included in the connection between the neutrals an impedance coil 21 which offers little resistance to the flow of power currents between the two systems from the normal and emergency sources. However, this impedance 21 is selected so as to have a high value with respect to the signal currents so as not to form a low impedance shunt for the source of signal energy. Thus whether switch 20 is open or closed does not substantially affect the signal level on the neutrals.

At 22 is a microphone or other suitable form of signal device feeding into any suitable and well known form of amplifier which has been diagrammatically indicated at 23. Preferably the output of the amplifier is fed into two or more separate transformers of which by way of example the secondaries 25 and 24 are shown. In view of statements made later it would be well to state that secondaries 25 and 24 may be connected in parallel so that the two main feeders have the same polarity, or in series so that the polarity of the two feeders is opposite with respect to ground. Each connection has apparent advantages and disadvantages. One terminal of each is shown with a common grounding connection 26 grounded on the hull. Under some conditions single transformers can be used with grounded tapped secondary. The other terminals of the secondary are connected through the condensers 27 and 28 to the neutral wires as shown. Thus condenser 27 is connected by wire 19 directly to the neutral 15 and condenser 28 is connected by the wire 10' to the wire 10 which extends to the other neutral 6. In other words, the wires 19 and 10' are connected to the neutral system on opposite sides of switch 20 and coil 21.

The signal responsive devices are connected across the two neutral wire systems. Thus, on the upper deck the neutrals 16 and 9 provide a conductive network for the signal responsive devices on that level. Connected across the wires 9 and 16 at the desired points are the primaries of the transformers 29 and 30. These primaries, which may be of two separate transformers or a

single transformer with a mid-tap, are grounded to the hull by the wire 31.

It is preferable to employ two separate transformers as distinguished from a single transformer having a mid-tap. This is desirable in order that if one of the lines to the speaker transformers is grounded a complete short circuit of the speaker will not result. Where a single transformer with a mid-tap is used a ground on one of the lines will either short the other circuit to the speaker or substantially reduce the volume of sound output therefrom. For this reason two separate transformers are preferably connected as illustrated so that the grounding of one of the lines will not interfere with the power volume operation of the associated speaker. The outside terminals of the primary are connected to the neutrals 16 and 9 through the condensers 32 and 33. The secondaries of the transformers 29 and 30 are connected in series with a signal responsive device 34, such as a loud speaker.

In accordance with this invention it is important that the speaker transformers 29 and 30 have together a small impedance of the order of 3 or 4 ohms so that the impedance of the speakers is matched with the impedance of the conductors, so that when one or more transformers and/or associated condensers and/or conducting channels are short circuited none of the speakers are affected and all remain operative. Thus only a short circuit directly across the secondaries of transformers 29 and 30 will render a speaker inoperative if the secondaries of transformers 29 and 30 are connected in series, and then only that particular loud speaker. The impedance in the circuit between any two speakers is always normally high enough so that a short circuit on one of the speakers does not render the adjacent speakers inoperative.

The above statement is true if the main feeders are fed from both ends as illustrated in Figure 1 with respect to all of the speakers connected thereto so that there is a potential drop between any other point on the feeders and the grounded point. For this reason it is desirable, as illustrated in Figure 1, to apply the signal energy from the extreme ends of each associated pair of feeders or neutrals. The other speakers on the same level and on the other levels are similarly connected between the neutrals. The dotted lines marked P represent the various metallic partitions or bulk heads in the hull of the vessel, and it is on these that the various speakers have been indicated as grounded.

In the normal operation of this system the signal energy is impressed over the condensers 27 and 28 and wires 19 and 10' onto the two neutral systems radiating from the neutrals 15 and 6. The other terminals of the output transformer impress the energy onto the hull of the ship through the grounded lead 26. Thus energy is supplied to each of the signal responsive devices independently over each of the neutrals and the hull of the ship to the grounding terminals 31.

In normal operation therefore the speakers are supplied with signal energy over both circuits. In the event that either circuit fails energy will be supplied nevertheless over the other circuit to the signal responsive devices. Thus for example, if the connection 15^a to the neutral 16 is accidentally or unintentionally grounded or short circuited, or opened, as indicated by the numeral F, the signal energy will be supplied from the amplifier 23 over the neutral 6, and its branch 9 to ground so that the speakers 34 connected thereto

will operate. Again, if both neutral branches 8 and 17 have an accidental ground on them, as indicated in dotted lines at F, all of the loud speakers will operate. Energy will be supplied to all of the speakers even with a direct short circuit across the primaries of transformers 29 and 30 or their respective feeders when each speaker is fed through parallel circuits and, therefore, there is always a potential difference between these circuits and ground. Here, as described above, the statement in the preceding sentence is true for all speakers connected to each pair of neutrals where the signal energy is applied to both ends of the circuit wires. A similar thing will occur if an accidental ground occurs on one or both of the neutral conductors 7 and 18 as indicated by the reference numeral F on the lower level, indicating accidental grounding of both of these neutrals. In the event that the main power generators 2 and 3 and their circuits become inoperative during an emergency at which time the normally closed switch 20 is open, the signal energy is still sent over all neutral circuits and their branches to effect operation of all of the loud speakers. Thus the system works whether or not switch 20 is open or closed, and whether or not one or the other of the circuits comprising the normal and emergency neutrals and their branches are inoperative either in part or in whole.

In the system of Figure 2 the neutral 6' of the generators 2 and 3 is connected by the various branch neutrals 7', 8', 9', 10', 11', 12', 13', 14' and 15'. The neutral 15' of the emergency generators 11 and 12 is connected through branch neutrals 51, 53, 57 and 57' and the emergency circuit. Neutral 51 is connected in a junction box B to the normal neutral system through condenser 52 and similarly emergency neutral 53 is connected to the normal neutral system through condenser 54, emergency 57 is connected through 58 to the normal, and emergency 57' is connected through the condenser 59 to the normal neutral system. Emergency neutral 15' is connected to the normal neutral 6' through a normally closed switch 20 and the connection 10', which is opened only in case of emergency. The microphone 22 as before feeds into an amplifier 23 of any suitable form, which in this case is provided with two distinct output transformers 24 and 25. The secondaries 44 and 45 of these transformers are provided with a common lead 46 which is grounded on the hull. The other terminal of secondary 44 is connected through condenser 42 to the neutral 15' and also through condenser 43 to the wire 10' which connects the two neutrals together. Thus the secondary 44 of the output transformer 24 is connected between ground and the two neutrals. The other terminal of secondary 45 is connected to wires 47 and 48 which on shipboard may be a "fan" circuit, or other available and suitable circuit, which in turn connect to the normal neutral system through the condensers 49 and 50 respectively by wire 46'. For purposes of clarity it is noted that wire 46' is not one of the existing wires of the ship's network, but is installed for the purpose. It is pointed out that a "fan" circuit normally differs from the ordinary lighting circuit in that it originates in a single panel box and exists as a single circuit throughout a large part of a ship. On the other hand, the individual lighting circuits normally feed no more than four or five staterooms. It is also noted that other existing circuits on shipboard having this characteristic may be employed, such as telephone circuits, bell signaling circuits, and other circuits

of a similar nature. The loud speakers 34 in this case each have one terminal grounded to the hull, as for example the partitions P as shown. The other terminal is connected between each adjacent normal neutral and either the wire 47 or the wire 48 through the condensers 60 and 61.

This system operates quite similarly to that previously described. In case the normal neutral system is inoperative the speakers are fed from the emergency neutral system through various condensers 52, 54, 58 and 59, and thence back through the hull of the ship. Here again the short circuiting of one or more speakers does not interfere with the operation of the remainder of the system. The system disclosed in this figure is particularly useful in connection with two-wire or three-wire direct current systems commonly found on shipboard. The various condensers prevent the grounding of either the emergency or the normal systems through each other. The values of the various condensers employed are such as to permit the passage of the signal frequencies quite similarly to the manner in which the condensers 32 and 33 act in the alternating current system of Figure 1. These condensers prevent the interflow of power current between the two systems without interfering with the interflow of signal currents.

The system of Figure 3 is further modified in that the output of the amplifier 23 is provided with four output transformers. In this case the normal neutral 6 is provided with the branches 70, 71, 72 and 73, and the emergency neutral 15 is provided with the branches 74, 75 and 76. The speakers are connected between the various neutrals through the transformers 29 and 30 and the condensers 32 and 33 as described in connection with the system of Figure 1. One side of each of the primaries of these transformers is grounded at 31. The output of the amplifier is provided with four output transformers 81, 82, 83 and 84. Their primaries are connected in series and the secondaries are connected so that one terminal of each is interconnected and provided with a common ground 85. The other terminal of each is connected through the condensers 77, 78, 79, 80 to the emergency neutrals 76 and 75, and the normal neutrals 71 and 72.

The connection between the normal and emergency neutral networks by wire 86 and impedance 91 and switch 90 in series permits an interflow of power between the systems. Impedance 91 and switch 90 correspond to impedance 21 and switch 20 of Figure 1. The operation of the speakers is the same as previously described, and the system provides independent circuits to each speaker so that it will operate as previously described.

A modification adapted for use with the general system of this invention is shown in Figure 4. At this time it is pointed out that the coupling transformers 24 and 25 may be either the output transformers of the amplifier which in the case of vacuum tube amplifiers would be connected in the plate circuits of the output vacuum tubes, or these coupling transformers may be additional transformers connected to the output transformer. The arrangement of Figure 4 clearly illustrates them as being the output transformers in the plate circuits of the output vacuum tubes VT. The output transformers are shown generally at 124 and 125. They comprise two part secondaries 124^a and 124^b and 125^a and 125^b respectively. The transformers have the single winding secondaries 124^c and 125^c respec-

tively. Each of these secondaries has a common grounded lead 26. The other terminals are connected to the feeder wires 19 and 10' as before which include the coupling condensers 27 and 28. With a connection of this type if a break or open circuit occurs in one of the feeders 19 or 10' near the amplifier the impedance of the transformer in that circuit becomes relatively high causing a considerable loss in volume over the other circuit. For this reason it is desirable to have some means of automatically short circuiting the secondary of the transformer in the open circuit. This is accomplished in accordance with Figure 1 by an automatically operating arrangement. Suitable impedances such as the resistances 175 and 176 are connected in series across the feeders 19 and 10' in order to supply a direct current path for the rectifier 130. These resistances have a common connection to the grounded common lead 26 through a condenser 127. Likewise connected in series across these feeders are a pair of magnets 128 and 129 with a common lead connected to ground through the condenser 127 and a rectifier 130. These magnets control a pair of switches 131 and 132. One contact of each of these switches respectively is connected to the feeders 19 and 10'. The other contacts of each of these switches have a common connection to the ground lead 26. When an open circuit occurs on one of the feeders 19 and 10' the voltage across the associated magnet 129 or 128 builds up to close the associated switch. The closing of this switch it will be apparent will be a direct shunt across an associated magnet so that it would immediately open. This would produce an undesirable condition which is prevented by means of the magnets 140 and 141. At 134 is shown the switch by means of which the transmitter of the system would be energized to put the entire system in operation. Thus switch 134 would control the microphone 22 and amplifier 23 and would close when energized the transmitter for operation. This provides a convenient control device therefore for the magnets 140 and 141, which are provided to prevent vibration of the switches 131 and 132. Switch 134 controls the circuit comprising the wires 136 and 137 having a suitable current source 135. Thus if switch 134 is closed and feeder 10' is open circuited for any reason, magnet 128 would be energized to close switch 132 at the same time it would close switch 138 energizing magnet 140 from the source 135. The magnetization of magnet 140 prevents switch 132 from opening thereby maintaining the short circuit across the feeder 10' of the common lead 26. The net result of all this is that all the signal energy from the amplifier will then go out over the circuit including transformer 124 and will not be absorbed and lost in transformer 125.

A simpler system is shown in Figure 5 particularly adapted for use on ships having alternating current power supply circuits. As before, the microphone 22 feeds into the amplifier 23 and the output transformers 24 and 25 are energized therefrom. They are provided with a common ground for one terminal of each and are directly connected at the other terminals to the main neutral and the emergency neutral and the main and emergency power supply circuits feed from the main generator and the emergency generator. It will be noted that condensers are not employed and are not necessary in the feeder wires from the output transformer in an alternating current system. As before,

these neutral systems may be interconnected by means of the switch 20 through the inductance 21. As before, the signal responsive devices or speakers 34 are connected in series with the secondaries of a pair of transformers 29 and 30. In this case the primaries of these transformers are wound in opposition and are connected across the main and emergency neutrals. As an alternative, with parallel connection at the transformers 24 and 25, either the primaries or the secondaries of transformers 29 and 30 may be connected in parallel. The common grounding lead 31 for these primaries includes the single condenser 31a as distinguished from the pair of condensers 32 and 33 as employed in the direct current system. Since with a system of this type no potential difference normally exists between the main and emergency neutrals with respect to the power supply, it is not necessary to provide a pair of condensers in the leads to each of the primaries of the transformers 29 and 30. Hence a single condenser in the ground lead is sufficient. With the arrangement illustrated the supply of current from the amplifiers into the two channels is in parallel. The primaries of the speaker transformers are in parallel with respect to the feeders but the secondaries are in series.

This arrangement has the advantage that if one of the neutrals is accidentally disconnected from the power supply and some power load remains in the circuit, this neutral will have a potential above ground, which would cause the reproduction of undesired noises within the loudspeaker. However, with the primaries wound in opposition the currents which produce the disturbing noises have no effect on the loud speaker but neutralize each other so that no undesired noises are produced in the loud speaker. The remaining channel through the feeder which is not open circuited will supply energy to the speaker at normal volume.

In Figure 6 there is illustrated a system in accordance with this invention employing carrier frequencies which are modulated by the voice signals. At 201 is disclosed a combined modulator and amplifier which is fed by means of the microphone 200 or other equivalent transmitter. At 202, 203 and 204 are diagrammatically illustrated control switches for the modulator by means of which any one of a plurality of carrier frequencies may be selected for use in transmission. The transformers 205 and 206 represent either the output transformers for the amplifier, or transformers connected to the output terminals in the amplifier as previously described.

The primaries are connected in series as are the secondaries which are provided with the common grounding connection 207. These transformers feed into the lines 208 and 209 through the coupling condensers 210 and 211 as before. Feeder 208 is connected to the emergency neutral EN of the emergency power system, and feeder 209 is connected to the main neutral MN of the main power supply system. As before, the inductance 212 and switch 213 are employed. The main and emergency neutrals extend to the panel boxes from which the branch neutrals radiate. An emergency branch neutral is indicated at E1 and a main branch neutral is shown at M1. The reproducing devices 221 are connected between pairs of main and emergency neutrals as shown. These devices are selectively operable each by one of the carrier frequencies of the

source. Thus the first reproducing device is connected across the output terminals of a rectifier bridge 220 the input terminals of which are fed by the secondaries of the transformers 214 and 215. The terminals of these secondaries are bridged by a tuned circuit 219 responsive to one of the carrier frequencies of the source. The primaries of these transformers are connected in series between E1 and M1 through the condensers 216 and 217. The primaries have a common grounded connection 218. The arrangement for the second reproducing device only differs from the first in that the tuned circuit 219' is tuned to respond to another of the carrier frequencies. The third reproducing device is shown connected to a rectifier bridge and supplied by an untuned circuit so as to be operable by all of the carrier frequencies.

With this arrangement it will be apparent that when one of the switches 202, 203 and 204 is closed the reproducing device will be operated whose tuned circuit responds to that particular frequency. When another is closed another of the reproducing devices is operated, and when the third is closed the third reproducing device is operated to the exclusion of the other two. Because the circuit of the third reproducing device is untuned it will also respond to the other two frequencies so that it will operate when each of the others operates.

It will be apparent to those skilled in the art that these principles may be employed in systems employing a large number of reproducing devices and be arranged so that a large number of reproducing devices at different spaced points will be simultaneously operated by a single one of the carrier frequencies.

The rectifiers employed in the rectifying bridges may be of any suitable form available for the purpose, such as copper oxide rectifiers and the like, vacuum tube rectifiers, etc.

The system of Figure 7 illustrates a rather simplified form of the invention in which the basic principle of supplying energy from a common signal source over a plurality of channels to each of a group of loud speakers is illustrated. As before, the main generators 2 and 3 are shown grounded to the hull of the ship by means of a connection which includes the impedance 7'. It is noted that in some cases the impedance represented by 7' may be nothing more than the impedance of the grounding wire to the hull. It is here emphasized, as is true of the other systems disclosed, that the principles of the invention may be applied to networks which are not grounded. The emergency generators are shown by 11 and 12 in the superstructure of the ship.

The main neutral feeder 6 is shown provided with the branch neutrals 6^a, 6^b, and 6^c running to the various panel boxes B. The emergency neutral 15 is shown provided with the branch neutrals 15^a, 15^b, and 15^c likewise running to separate normal and emergency circuit panel boxes B. The switch 20 is provided as before to interconnect the main and branch neutrals in the normal operation of the main and emergency power systems. As before, a microphone or its equivalent 22 feeds into a suitable form of amplifier 23, one terminal of which is grounded by the wire 26' on the metal hull of the ship. The other terminal is connected by the wire 27' to the main and emergency neutrals through the condensers 27^a and 27^b respectively. The main branch neutrals 6^a, 6^b and 6^c are shown running from the panel boxes to which the branch neu-

trals 6^b and 6^c extend. The emergency branch neutrals 15^a and 15^b are shown extending from the panel boxes to which the emergency neutrals 15^b and 15^c extend. The main branch neutrals 6^a, 6^b, and 6^c, and the emergency branch neutrals 15^a and 15^b represent a "fan" or lighting circuit extending from the panel boxes.

A feature of this form of the invention involves the interconnection of main branch neutrals to main branch neutrals, emergency branch neutrals to emergency branch neutrals, and main branch neutrals to emergency branch neutrals. Thus condenser C' connects the emergency branch neutral 15^a to the main branch neutral 6^a. Condenser C² connects the main branch neutral 6^b to the main branch neutral 6^a. Condenser C³ connects the main branch neutral 6^b to the emergency branch neutral 15^c. Condenser C⁴ connects the main branch neutral 6^a to the emergency branch neutral 15^b. Condenser C⁵ interconnects the emergency branch neutrals 15^a and 15^b. The branch neutrals are not normally interconnected but the above connections through condensers are made to produce a system in accordance with the invention.

A series of signal responsive devices, as for example loud speakers 34, 34', 34², 34³, 34⁴, 34⁵, 34⁶ and 34⁷ are connected between the various branch neutrals, main and emergency, to ground on the metal walls or decks P of the ship through the condensers 33^a.

Circuits may be traced to the reproducing devices 34', 34² and 34³ over two channels. Energy is supplied from the amplifier 23 to these speakers over the circuit comprising the wires 15^a, and 6^a. Energy is also fed from the amplifier over wire 6, wire 6^b and wire 6^c to wire 6^a. Thus the grounding or opening of either of these separate circuits will not render more than one of these three speakers inoperative even then only a ground from near one of the speakers, and then only the speaker nearest that ground.

Thus with this system in addition to providing safe and dependable operation under all conditions, the circuit arrangement is such that the volume level of the signals at the speakers is automatically distributed throughout the entire network. This is an exceedingly important feature of this arrangement.

Speakers 34⁴ and 34⁵ are fed in two directions from wire 6^c and from wire 43. Thus a connection to ground on one of the branch neutrals or a direct short circuit of a speaker can affect only one of these speakers.

The application of the invention to a system where the main and emergency neutrals both extend to the same panel boxes is shown in connection with the speakers 34⁶ and 34⁷. With this connection energy is fed over two separate channels to these speakers from the emergency neutral 15^b and the main neutral 6. The interconnection between the branch emergency neutrals through the condenser C⁵ completes the circuits to the two speakers in both directions. Thus, for example if the emergency branch neutral 15^a is grounded as indicated at F, both of these speakers will receive their energy over the neutral 15^b through the condenser C⁵. An open circuit in either of these channels will not prevent the operation of both of the speakers.

It will be noted that in the arrangement of Figure 7 there are three distinct combinations of the neutrals, any one of which may be used throughout the entire ship to the exclusion of

the others, or any two, as well as all three may be used.

Thus the main object of this invention of securing dependability under all possible conditions of operation is secured.

From the above description it will be apparent that this invention resides in certain principles of arrangement and connection which may be embodied in other physical forms without departure from the true scope thereof. We do not, therefore, desire to be strictly limited to the disclosure as given for purposes of illustration, but rather to the scope of the appended claims.

What we seek to secure by United States Letters Patent is:

1. In a signaling system the combination comprising a pair of grounded networks, a grounded signal source coupled to said network for impressing a common signal current upon both of said networks, a plurality of signal responsive devices each connected between said networks and each having a pair of grounded coupling devices connected between said networks for supplying energy from the network to said signal responsive devices simultaneously over two paths or over either path during an open circuit or a short circuit on the other.

2. In a signaling system of the type described the combination comprising a pair of grounded networks, a grounded signal device coupled to the networks for supplying a common signal current to both, a plurality of signal responsive devices, and means connected between each of said networks and ground for supplying energy to said devices simultaneously over two paths or over either path during an open circuit or a short circuit on the other.

3. In a signaling system of the type described the combination comprising a pair of grounded networks, a grounded signal device connected to said networks for supplying a common signal current to both, a plurality of signal responsive devices, and low impedance means connected between each of said networks and ground for supplying energy to said devices simultaneously over two paths or over either path during an open circuit or a short circuit on the other.

4. In a signaling system of the type described the combination comprising at least two grounded conductors, a grounded signal source connected to said conductors for applying a common signaling current to said conductors, and a plurality of signal responsive devices each connected between said conductors and ground whereby the signal current is supplied thereto over both conductors or over either during short circuit or open circuit on the other.

5. In a signaling system of the type described the combination comprising a grounded network, a grounded source of signal energy for applying a signal current to said network at spaced points, a plurality of signal responsive devices, a pair of impedance means connected between spaced points on the network, means providing a common ground for said impedance devices, and means for connecting the signal responsive devices respectively to said impedance devices.

6. In a signaling system the combination comprising a grounded conductive network, means for applying a signaling current to said network at spaced points, a plurality of signal responsive devices, and grounded coupling devices for connecting said signal responsive devices to the network at spaced points, whereby signals reach each

signal responsive device over two different portions of said network.

7. In a signaling system the combination comprising a grounded conductive network, means for applying a signaling current to said network at spaced points, a plurality of signal responsive devices, and means for connecting said signal responsive devices to the network each comprising a transformer having its primary connected through a condenser to the network, a common ground for the primaries, and means for connecting each signal responsive device in series with the secondaries of a pair of primaries having a common ground.

8. In a signaling system the combination comprising a grounded conductive network, means for applying a signaling current to said network at spaced points, a plurality of signal responsive devices, means for connecting each signal responsive device to the network each comprising two condensers connected in series across the network at two spaced points, each signal responsive device being connected between ground and the mid-point of a pair of said condensers.

9. In a signaling system the combination comprising a grounded network, a source of signal energy having two output transformers, a common ground for the secondaries of the transformers, means for connecting the other terminals of the secondaries to spaced points on the network, a plurality of signal responsive devices, and a pair of low impedance devices having a common ground and connected between spaced points on the network for connecting each signal responsive device to the network.

10. In a signaling system on shipboard, the combination comprising a network composed of the grounded neutrals of the main and emergency power systems, grounded signal means for impressing a common signal on both of said neutrals, a plurality of signal responsive devices, and low impedance means having a common ground and connected between the said neutrals for operating the respective signal responsive devices.

11. In a signaling system on shipboard, the combination comprising a network composed of the grounded neutrals of the main and emergency power systems, grounded signal means for impressing a common signal on both of said neutrals, a pair of transformers for each signal responsive device, means for connecting the primaries of each pair of transformers in series across the normal and emergency neutrals through condensers, a common ground for the primaries, and means for connecting the signal responsive devices and the secondaries of each pair in series.

12. In a signaling system on shipboard, the combination comprising a network composed of the grounded neutrals of the main and emergency power systems, grounded signal means for impressing a common signal on both of said neutrals, a pair of condensers connected in series across the normal and emergency neutrals for each signal responsive device, a connection from each signal responsive device to the common terminal of the associated pair of condensers, and means for grounding the other terminal of the signal responsive device.

13. In a signaling system for use on shipboard, the combination comprising a network composed of the normal and emergency grounded power circuit neutrals, a source of energy having a pair of output transformers, a common ground for one terminal of each of the secondaries of the output transformers, means for connecting the

other terminals of the secondaries to the network at spaced points, a plurality of signal responsive devices, low impedance coupling means connected between the normal and emergency neutrals and having a common ground, and means for coupling the signal responsive devices to said low impedance coupling means respectively.

14. In a signaling system for use on shipboard, the combination comprising a grounded network composed of the neutral wires of the normal and emergency power circuits, means for generating a signal current having a plurality of output transformers, means for providing a common ground for the secondaries of all of said transformers, means for connecting the other terminals of the secondaries to the network at spaced points, a plurality of signal responsive devices, and means comprising a pair of grounded low impedance devices connected between the normal and emergency neutrals for coupling the signal responsive devices respectively to the network.

15. In a signaling system for use on shipboard, the combination comprising a network composed of the grounded neutrals of the main and emergency power systems, a grounded signal source, a pair of coupling transformers fed from said source, said transformers having a common ground for one terminal of each, means for connecting the other terminals of the transformers to the main and emergency neutral systems respectively, a plurality of grounded signal responsive devices each connected between the main and emergency neutral systems, and means for automatically short circuiting the secondaries of either of said coupling transformers upon the development of an open circuit in the means for connecting them to the main and emergency neutrals.

16. In a signaling system for use on shipboard, the combination comprising a conductive network composed of main and emergency power circuit neutrals, means for impressing signal energy upon the network thus formed, a plurality of signal responsive devices, a pair of transformers for each of said devices, the secondaries of each pair being connected in series with the associated device, the primaries of each pair of transformers being oppositely wound and connected in series across the main and emergency neutrals, and a common ground for the primaries having an impedance therein.

17. In a signaling system for use on shipboard and the like, the combination comprising a conductive network composed of main and emergency power neutrals, a transmitter for impressing signal energy upon the network thus formed, a plurality of signal responsive devices, a pair of transformers for each of said devices, the primaries of the transformers being connected in series between the main and emergency neutrals and having a common ground, and connections between the secondaries of the associated pair of transformers and a signal responsive device.

18. In a signaling system the combination comprising a pair of separate conducting networks, means for interconnecting the networks to effect signal energy transfer therebetween, a common source of signal energy connected to both networks to energize them, and a plurality of signal responsive devices connected to both of said networks whereby energy is supplied to each signal responsive device from both networks or from either upon failure of the other by short circuit.

19. In a signaling system the combination comprising a conductive network, an impedance con-

nected into said network to isolate it substantially into two portions with respect to the currents to be transmitted thereover, a grounded source of signal energy connected to the portions of the network on opposite sides of said impedance, and a plurality of signal responsive devices connected between said portions of the network on opposite sides of said impedance whereby a common signal is transmitted to each of said devices over said portions of the network.

20. In a signaling system the combination comprising a conductive network, an impedance connected into said network to isolate it substantially into two portions with respect to the currents to be transmitted thereover, a grounded source of signal energy connected to the portions of the network on opposite sides of said impedance, a plurality of signal responsive devices, and grounded coupling means for each of the signal responsive devices for individually connecting them to said portions of the network.

21. In a signaling system the combination comprising a conductive network, an impedance connected into said network to isolate it substantially into two portions with respect to the currents to be transmitted thereover, a grounded source of signal energy connected to the portions of the network on opposite sides of said impedance, a plurality of signal responsive devices, and grounded coupling means for each of the signal responsive devices for individually connecting them to said portions of the network, said grounded coupling means comprising a pair of condensers connected in series across said portions of the network and having their common points grounded.

22. In a signaling system the combination comprising a conductive network, an impedance connected into said network to isolate it substantially into two portions with respect to the currents to be transmitted thereover, a grounded source of signal energy connected to the portions of the network on opposite sides of said impedance, a plurality of signal responsive devices, and grounded coupling means for each of the signal responsive devices for individually connecting them to said portions of the network, said means comprising a pair of transformers, the primaries of which are connected in series across the said portions of the network and having a common ground, the signal responsive devices being respectively connected to the secondaries of said pairs of transformers in series therewith.

23. In a signaling system the combination comprising a conductive network, an impedance connected into said network to isolate it substantially into two portions with respect to the currents to be transmitted thereover, a grounded source of signal energy connected to the portions of the network on opposite sides of said impedance, a plurality of signal responsive devices, and grounded coupling means for each of the signal responsive devices for individually connecting them to said portions of the network, said means comprising a pair of transformers, the primaries of which are connected in series across the said portions of the network and having a common ground, the signal responsive devices being respectively connected to the secondaries of said pairs of transformers in series therewith, said primaries being isolated from said portions of the network by condensers.

24. In a signaling system the combination comprising a conductive network, a plurality of signal responsive devices connected between spaced points on said network, a common source of sig-

nal energy, and means for coupling the source to said network including a pair of transformers, the secondaries of which are connected in series and to said network at a pair of spaced points, the common terminal of the secondaries being grounded.

25. In a signaling system, the combination comprising a pair of conducting channels, means for impressing a common signal current simultaneously upon both of said channels, and a plurality

of signal responsive devices coupled to both of said channels including means for supplying current from both of said channels to each of said devices simultaneously or from either of said channels during an open circuit or a short circuit on the other.

IRVING F. DURST.
SEMI JOSEPH BEGUN.
HERBERT BARNETT. 10