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H. KIETZ ET AL
DEVICE FOR DIRECTED RECEPTION
OF WAVE MOTIONS
Filed July 10, 1940

Serial No.
344,790
2 Sheets-Sheet 1

FIG. 1.

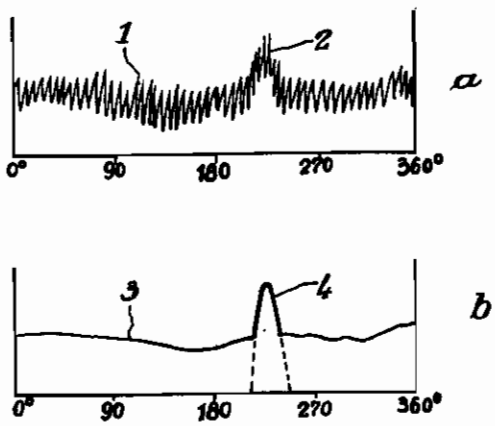

FIG. 2.

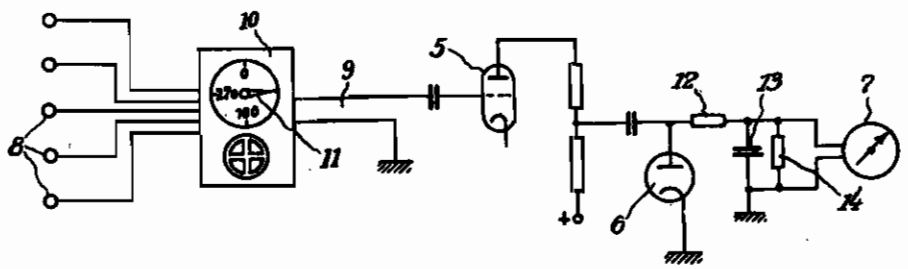

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FIG. 3.

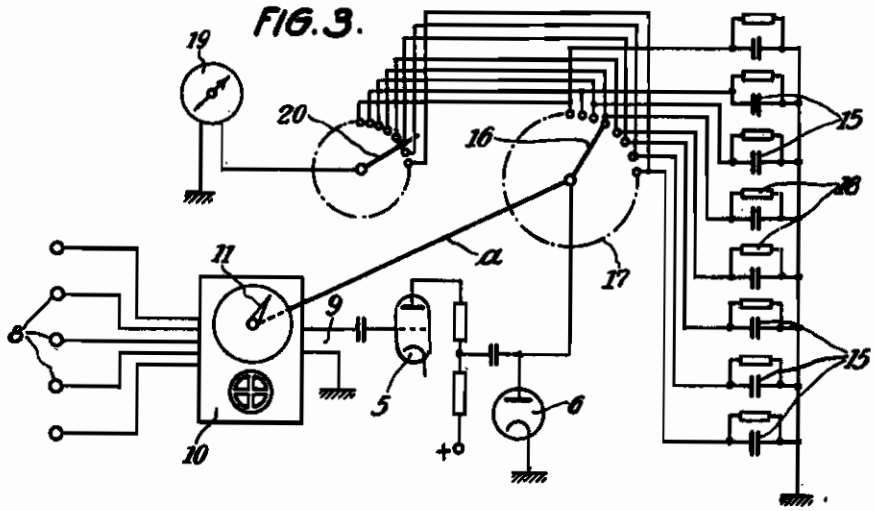


FIG. 4.

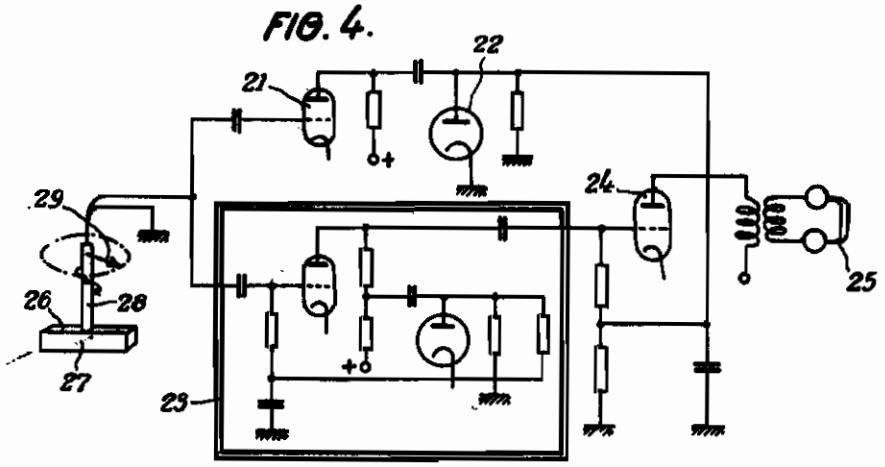
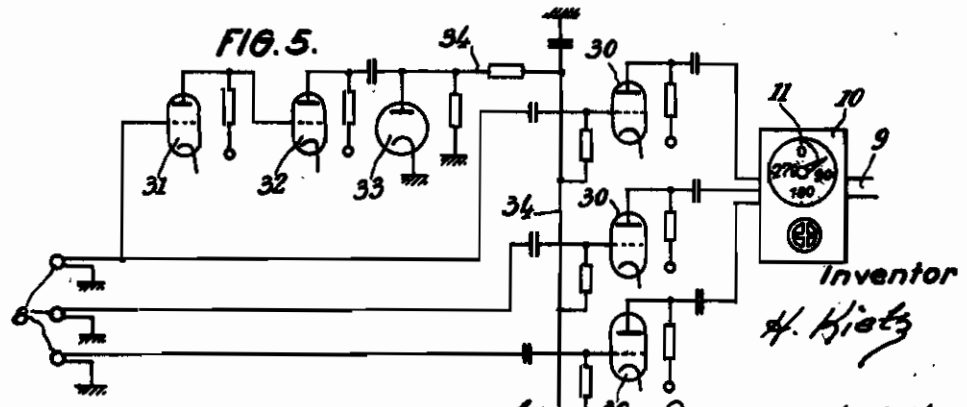


FIG. 5.



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ALIEN PROPERTY CUSTODIAN

DEVICE FOR DIRECTED RECEPTION OF WAVE MOTIONS

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Application filed July 10, 1940

In the directed reception of wave motions, especially for finding and for determining the direction of the sources of noise in water, the waves received are always accompanied by more or less intense disturbances. These disturbances are particularly aggravating inasmuch as they are mostly subject to great temporary fluctuations of the intensity, and as the ear responds especially to fluctuations of the intensity. Therefore, if the useful optimum intensity does not exceed by a multiple the intensity of the disturbances, it is difficult for the observer to distinguish it from the disturbances.

According to the invention, these disadvantages may be obviated by providing means for calming the temporary fluctuations of the receiving amplitude. Thus, it is attained that the useful amplitudes, if they merely exceed the general disturbance level, do not get lost in the disturbing maxima but are clearly distinguished from the disturbing amplitudes. With an objective, for example optical, indication it is possible to considerably increase the sensitivity of the receiving device or to remove the danger that any disturbing maxima, even of a large amplitude, are indicated.

The calming may be effected by forming a mean value of the receiving amplitudes for a certain period as well as by regulating the intensity in a manner similar to that known in regulating the fading in wireless telegraphy. In receiving devices with an adjustment of the directing vector in the range to be covered, there might be the danger that by moving through the chief maximum, this maximum is levelled by the calming to such a degree that it is not possible to distinguish it from the disturbing sound. In order to avoid such a disadvantageous effect, means may be provided which to a certain degree limit the adjusting speed for the directing vector with respect to the degree of calming in such a manner that the useful optimum sound is not removed by the calming means. For example, in forming the mean value, the adjusting speed for the directing vector may be limited with respect to the degree of calming in such a manner that the fluctuations of the intensity are too slow to be calmed when moving through the useful optimum.

Advantageously, the mean value is only formed for a certain bearing direction, for example by a continuous rapid rotation of the adjusting apparatus or of the directing vector and by coordinating to each adjusting position an indicating or indication control member, which is excited in rhythm with the revolutions of the directing vector by the receiving amplitudes so as to adjust itself to a mean amplitude for several succeeding revolutions of the directing vector. The mean value may be optically indicated. If it is desired to hear the noise received in its natural form, the forming of the mean value may be combined with a rapidly acting fading regulation so as to level the intensity fluctuations and to reproduce the removed useful optimum by the mean value, for example by using a regulating valve.

If the receiving device is provided with a group of receivers, the calming means may be applied at a place, for example in the individual receiving circuits, where the adjusting fluctuations do not yet occur.

The temporary calming of the disturbing level provided according to the invention, not only facilitates finding the direction by the acoustical method of listening, but also secures the advantage to change the hearing reception to an objective indication of the direction of the sources of noise by optical signs and by registration.

Several constructional examples of the invention are illustrated in the accompanying drawing, in which:

Figs. 1*a* and 1*b* are diagrams illustrating the effect of the invention,

Fig. 2 is a bearing device with formation of mean values and optical indication,

Fig. 3 is a bearing device with formation of mean values and individual indication for the various bearing directions,

Fig. 4 is a bearing device with fading regulation and formation of mean values, with acoustical indication,

Fig. 5 is a bearing device with a group of receivers and fading regulation in the individual receiving circuits.

In Fig. 1 the sound intensity, when bearing a ship's noise in water, is illustated in dependence of the direction of the observation place in curve 1, as it will result as receiving intensity, for example by moving a directed receiver over the entire circumference. The point 2 is to indicate the useful sound coming from another ship, the direction of incidence of this sound being required for finding the other ship's place, whereas the remaining portions of the curve illustrate the

disturbing sound caused by the water or the own ship. This disturbing sound is usually subject to intense temporary fluctuations. Although its mean value may be far below that of the useful sound **2**, it may easily occur, owing to the temporary fluctuations, that the disturbing maxima become equal to or even greater than the useful sound, so that the latter will be lost in the disturbing maxima and will be very different to hear as useful sound in the disturbing maxima when turning the receiving device.

These influences of the disturbing sound or of its temporary fluctuations of intensity are avoided in the bearing device illustrated by suppressing the temporary fluctuations by the formation of mean values or by fading regulation; thus, a bearing curve **3** with a useful sound **4** will result as in Fig. 1*b*.

Figs. 2 to 5 show connections of bearing devices in which the calming of the temporary fluctuations of intensity is obtained in different ways.

In the constructional example shown in Fig. 2, the calming is effected by forming for a certain period the mean value of the continuous voltage resulting from the receiving voltage after being amplified in an amplifying tube **5** and rectified in a rectifier **6**, this mean value being indicated in a tube voltmeter **7**.

The input of the receiving amplifier is connected to a group of five receivers **8**, which are fixed, for example, in the planking of the ship, and whose directing vector may be moved over the circumference in a manner known per se by inserting retarding lines of different lengths between the individual receivers and the common receiving circuit **9** in a compensator **10** with a hand wheel and a direction indicator **11**.

The length of the period, for which the mean value is formed, is determined by a time circuit consisting of a charging resistance **12**, a condenser **13**, and a leakage resistance **14**. It is obvious that the adjustment of the directing vector at the compensator **10** must be effected slowly enough to obtain an effective formation of the mean value of the useful optimum. The time constant of the formation of the mean value may be automatically influenced in dependence of the adjusting speed, or a certain adjusting speed may be predetermined.

The formation of a mean value for a long period with a high adjusting speed may be obtained by providing, as shown in Fig. 3, a larger number of condensers **15** or other storage members coordinated to the various bearing directions, the storage members being successively connected to the rectifier **6** by a contact device **16** coupled to the adjusting device and by a collector **17**. A rigid or flexible shaft *a* serves to couple the adjusting device to the contact device **16**. The directing vector is continuously rotated by mechanical driving means at a comparatively high speed, the individual condensers receiving with each revolution one charging current impulse according to the existing receiving amplitude. The leakage resistances **18** are so adjusted that mean voltages at the condensers **15** are obtained for several revolutions of the directing vector. The voltages at the condensers **15** are measured by a tube voltmeter **19** which may be successively connected to the individual condensers by means of a hand switch **20**. It is also possible to co-ordinate a special tube voltmeter or other voltage measuring member to each condenser **15**, or the voltages may be tapped in rapid succession by a Braun-tube with simultaneous deflection of the bearing direction, resulting in a permanent indication of the mean receiving amplitude of all directions.

With the indication of the mean value of the continuous voltage according to Figs. 2 and 3, the tone character of the noise received is lost. But in case of intense disturbances, the tone or other sound character often is an important sign. Fig. **4** shows a connection in which the noise received may be heard in spite of the formation of a mean value. For this purpose, the mean value of the continuous voltage, formed in an amplifier **21** with the adjoining rectifier **22**, is not directly indicated but is used for the dynamical regulation of the intensity of sound of the noise levelled by fading regulation in a second amplifier **23** connected in parallel, by applying the mean value of the continuous voltage as positive grid bias to an amplifying tube **24** lying behind the fading regulation. Then, the mean value of the amplitude of the natural noise may be heard in a telephone **25**. In this case, the fading regulation of the amplifier **23** may be omitted.

As shown in Fig. 4 on the left, the receiving device may be adjusted by mechanical turning in the various bearing directions instead of by adjustable electric retarding members. In this case, there may be provided a single oscillator **26**, preferably with a strip-shaped receiving surface **27** for obtaining the horizontal directing effect, rotatable about a vertical axle **28** connected with a direction indicator **29**.

In group listening devices, a fading regulation independent of the adjusting speed may be effected by inserting, as shown in Fig. 5, the fading regulation in front of the adjusting device in the branches of the individual receivers. In this case, preliminary tubes **30** are inserted in the individual receiver circuits. The voltage for regulating the preliminary tubes may be derived, as provided in the example, from one single receiver, for example by a two-stage amplifier **31**, **32** with an adjoining rectifier **33**, and applied via a common line **34** to all preliminary tubes **30** as negative bias for the fading regulation. In this case, the bearing adjustment may be effected either mechanically by turning the receiver group **8**, **8** . . . or, as shown in the drawing, by artificial turning with the aid of a compensator **10**.

Of course, the invention is not limited to the examples illustrated, as various modifications and other constructions are possible. In particular, the bearing devices may advantageously be provided with devices for registering the receiving amplitude. It is also possible to effect a calming of the receiving amplitude by forming a mean value not influenced by the bearing adjustment by providing a larger number of fixed directed receivers for the various bearing devices. In this case, each individual receiver may be provided with a separate indicating device, or a common indicating device may be successively connected to the individual receiving circuits. Furthermore, a calming according to the formation of a mean value may be provided in the individual receiver circuits of a group listening device, in which case the calming must be effected in such a manner that the noise frequencies to be heard are not levelled thereby.

If necessary, a calming may be effected behind the adjusting device by fading regulation.

In order that, in this case, the useful sound to be ascertained should not also be levelled by the

fading regulation, the latter must operate so slowly that the useful sound optimum is not influenced when the receiving vector is turned. Of course, all intensity fluctuations increasing and decreasing with the same speed as the useful optimum, will not be influenced by the fading regulation, but merely the slower fluctuations.

If the directing vector at the condenser is arbitrarily adjusted by hand, it is possible, if desired, to automatically accelerate or retard the fading regulation with the adjusting speed. But it is also possible to provide mechanical driving means for the compensator in order to secure a constant adjusting speed.

The fading regulation may, as known from the wireless technics, be connected with a device for removing the clicking.

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