Feb. 7, 1950 J. W. RICHARDT, JR., ET AL 2,496,639

AID FOR THE BLIND

Filed April 26, 1946

FIG. 1.

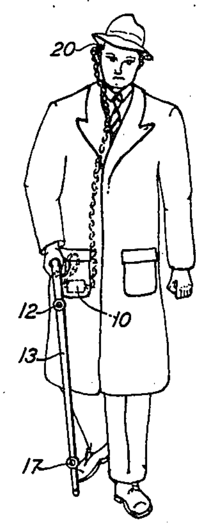


FIG. 2.

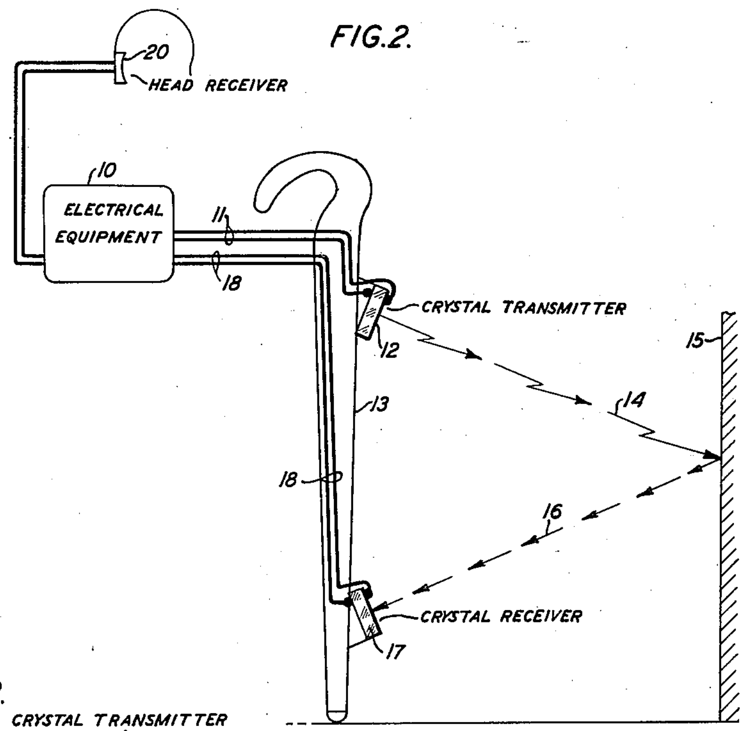


FIG. 3.

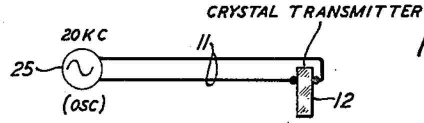


FIG. 4.

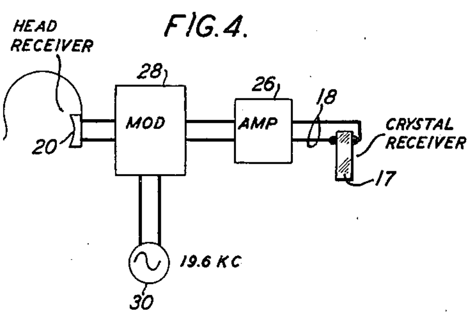


FIG. 5.

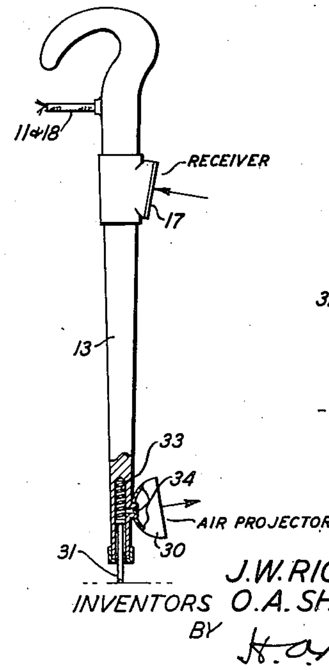
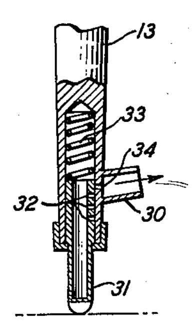


FIG. 6.



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AID FOR THE BLIND

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4 Claims. (Cl. 177—352)

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This invention pertains to sound wave apparatus and more specifically to such apparatus, characterized by the generation and detection of pressure waves in the atmosphere, adapted for use by blind persons as an aid in locomotion.

It has long been common practice for blind persons to determine the proximity of large objects in their immediate vicinity by detecting an audible frequency sound wave reflected from the surface of the object. In some cases the tapping of a cane or walking stick on the pavement has provided a source of audible sound the reflection of which has been observed by the blind person.

The reflective properties of such sound waves, which is displayed when a change occurs in the impedance of the transmission path of the wave, has been recognized and applied in other applications. A number of devices have been devised for using reflected sound as an aid in the detection of unseen objects or in measuring distances to such objects, as exemplified by equipment installed on ships or aircraft. Such apparatus has been comparatively large involving both weight and bulk.

It is an object of this invention to utilize the reflective property of sound waves in light-weight portable apparatus adapted to be worn and carried by blind persons for use in detecting objects in their immediate vicinity with considerably greater ease and effectiveness than can be done by tapping of a cane or by other ordinary methods.

Because of the variety of and the confusing nature of the audible frequency sounds present in most public places, it is apparent that objects may be more definitely apprehended by the reflection of an individual sound wave easily identified by the user. The sound wave should be under the complete control of the user and should be of a frequency that will not interfere with other normal activities in the vicinity of the user. It should also be of such a nature that it will not attract undue and embarrassing attention to the user.

It is accordingly an object of this invention to utilize supersonic or ultrasonic sound waves in this light-weight portable apparatus. The selected frequency will to some extent be under the control of the user but in any event will be sufficiently high so as to be beyond the unaided hearing capacities of normal human beings. In addition to this non-interfering character of these waves, the use of frequencies considerably higher than normal audible frequencies makes

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relatively easy their directional projection in a distributional pattern sufficiently sharp or concentrated to give good directional perception.

Since for most transducers employed in transferring energy from a medium of one impedance to a second medium of a different impedance the beam characteristic is sharpened, or narrowed as the frequency is increased, it follows that for any given size transmitter the use of supersonic frequencies permits more accurate location of objects than does the use of audible frequency sound waves.

As the apparatus provided by this invention is intended to be worn or carried by the user, it is desirable that its size and weight be confined to minimum quantities. In one embodiment it uses electrical energy in the form of miniature electric battery packs as the prime source of transmitted energy. The generated electric wave energy is converted to acoustic or sound wave energy in the transmitting unit by utilizing the converse piezoelectric properties of the included crystal element. An identical unit, utilizing the normal piezoelectric properties of its included crystal element is used as the receiving or "pick-up" unit. By operating at supersonic frequencies the physical dimensions of these units may be held to a minimum without sacrificing narrowness or concentration of the energy beam.

In another embodiment of the invention the entire electric transmitting system is eliminated in favor of using a pneumatically operated whistle, the driving force of which is generated by tapping or forcing the end of the cane downward against the pavement.

The nature of the invention will be more fully understood from the following detailed description and by reference to the accompanying drawings, of which:

Fig. 1 shows the general arrangement of the equipment in its preferred embodiment;

Fig. 2 is a block diagrammatic sectional view of the system showing the transmitter and receiver in spaced relation with their axes of maximum sensitivity converging and indicating the general path followed by the transmitted and reflected energy waves;

Fig. 3 shows the transmitting system indicating the source of supersonic wave energy connected to the crystal transmitter;

Fig. 4 shows the system for receiving the reflected supersonic energy waves and for their conversion to audible warning signals for the blind user;

Fig. 5 shows an embodiment of the invention employing an air projector as a source of supersonic energy instead of the electronic equipment of Fig. 3; and

Fig. 6 shows a sectional view of the air projector arranged as a source of pulsing supersonic energy.

The electrical equipment of Fig. 2, the details of which are not shown, should be understood as comprising the source of supersonic wave energy, the receiving amplifier, the source of conversion energy and the modulator equipment together with the interconnecting means. These items may be of any conventional design, of which a number of each are well known to persons skilled in the electronic art.

Referring to Figs. 1 to 4, the crystal transmitter 12 and crystal receiver 17 are of the conventional directional projector and directional pickup type each having an axis of maximum sensitivity perpendicular to the face of the unit. These units are mounted on a single mounting, such as a cane, and in a fixed angular relationship such that their axes of maximum sensitivity converge so that the receiver will be actuated primarily by the projected energy waves which are returned from reflecting surfaces in the vicinity of the units.

The performance of this apparatus is as follows:

Supersonic electric wave energy generated by the oscillator 25, which is contained in the electrical equipment 10, is transmitted over the interconnecting circuit 11 to the transmitter 12 where the electric energy is converted to supersonic pressure waves in the atmosphere, by virtue of the converse piezoelectric properties of the crystal element of the transmitter unit. This supersonic energy is radiated by the transmitter in a distributional manner determined by the directional characteristic of the transmitting unit, in that the major part of the energy is concentrated along the axis of maximum sensitivity 14. This energy wave continues outward from the transmitter until dissipated or until it encounters a reflecting surface 15. If an obstacle presenting a reflecting surface 15 is in the path of this energy wave a portion of the energy will be reflected back along the path of maximum receiver sensitivity 16 to the receiver 17. The amount of the projected energy which will be returned to the receiving unit 17 is a function of a number of factors, namely, the length of the transmission path to and from the obstacle, the nature of the object, the size of the reflecting surface or surfaces and the "scattering" at the reflecting surface.

The reflected supersonic wave energy returning along the axis 16 of maximum sensitivity of the receiver unit 17 impinges upon the face of the unit and by virtue of the piezoelectric effect of the crystal element of the receiver this pressure wave is converted into an electrical energy wave of the same frequency as the original electric wave produced by the transmitting oscillator 25. Interconnecting circuit 18 transfers this receiver electric wave to the electrical equipment 10 where the amplifier 26, modulator 28 and oscillator 30 with their associated interconnecting circuits are located. The received electric wave is reinforced by the amplifier 26 before being modulated in the modulator 28 where it is combined with an electric energy wave derived from the receiving oscillator 30 to produce an audible difference frequency that is heard in the headphone 20. The receiving oscillator 30 differs in frequency from the transmitting oscillator 25 by an amount corresponding to any predetermined audible frequency, such as 400 cycles in the illustrative example.

Whenever an obstacle possessing an adequate reflecting surface is interposed in the energy pattern of the transmitter thereby causing a portion of the transmitted energy to be reflected, the blind user of the equipment receives an audible warning signal. Means for adjusting the reinforcement imparted by the amplifier 26 to the electric wave generated by the reflected energy wave may be provided by the use of a volume control unit (not shown) located in any convenient position on the handle of the mounting member. This would permit adjusting the received signal to any level chosen by the user, and would also permit varying the effective operating range. The position of the control together with the strength of the observed signal might form a readily recognizable standard for gauging the approximate distance to the obstruction. If desired, a small change in the frequency of the receiving oscillator 30, may be made controllable from a suitable control (not shown) mounted on the handle of the mounting member to permit small identifying frequency changes or small changes to improve the signal-to-noise ratio.

It is not necessary that the transmitter and receiver be mounted in the exact relation as shown. They may be interchanged in position. In fact it is not necessary that the transmitter be of the previously described electronic form but as indicated in Fig. 5 is may be an air-operated device capable of producing supersonic energy waves of the desired frequency.

As shown in Fig. 6 this air-operated device may take the form of a whistle similar to the well-known whistles for animals, such as dogs, and which operate at a supersonic frequency inaudible to human beings. This whistle or air projector has its component parts properly proportioned to produce the desired frequency and is operated by tapping or forcing the end of the cane upon the pavement. The bottom portion of the cane 13 forms a chamber into which is fitted a retractible plunger 31 and a helical spring 33 for returning the plunger to its original extended position when the downward pressure on the cane is released. The plunger 31 may be of a solid piston type so located that it expels a single blast of supersonic energy through the exhaust port 34 each time it is forced into the chamber or it may take the form of a hollow cylinder closed at the bottom and with a vertical row of openings through the wall in a manner forming a vertical row of exhaust ports 32 so that supersonic energy is expelled only when one of the plunger exhaust ports 32 coincides with the chamber exhaust port 34, thereby forming a pulsing or interrupted energy output. This exhaust port 34 permits the escaping air to form supersonic pressure energy waves the frequency of which is determined by the proportional size of the component parts of the projector mechanism. If desired, a beam-forming reflector 39 may be provided to impart directional characteristics to the pressure waves so produced. The dimensions of the reflector would depend upon the frequency of the supersonic energy as well as the desired sharpness of the projector beam.

Utilization of an air-operated source of supersonic wave energy will, of course, make unnecessary the provision of the transmitting oscillator

!5 and transmitter 12 of Fig. 3. It is readily ıpparent that the obstructing surface may be :xplored by training the transmitter and receiver n a horizontal and vertical manner over its surace, the boundary locations being indicated by he positions where the audible signal is lost or nitiated depending upon whether the transmiter energy waves are reflected or continue in unmpeded progress.

Objects moving toward or away from the user nay be distinguished from stationary objects by he "Doppler effect" evidenced by a changing ›itch in the observed audible warning signal.

It is to be understood that the particular values or frequencies of the waves are given by way of llustration and are not to be taken as limiting he invention to these particular frequencies. 'arious modifications of this invention will occur o persons skilled in the art. The invention is o be limited only by the scope of the appended laims.

What is claimed is:

1. A portable aid for the blind comprising a ›ortable mounting member having a distant end ınd a handle end, said member being adapted or manual carriage and control and having a ross-sectional dimension that is small in comıarison to its length, a pneumatically operated upersonic acoustic wave generator and conıected thereto a directional transmitter for ›ropagating said generated wave energy, a diectional acoustic wave receiver for receiving relected portions of said energy, said generator ›eing so mounted at the distant end of said nounting member as to be activated by pneunatic pressure generated by forcing said distant nd of said member against an unyielding surace, said transmitter and receiver being mounted ›n said mounting member in fixed spacial relaion such that their axes of maximum response ntersect at an acute angle at a point removed rom said means, said receiver being located inermediate said transmitter and said handle end ›f said mounting member, modulation means or converting the output of said receiver into ıudio frequency electric waves, translating neans for converting said electric waves into ıudible sound waves, and flexible conductive neans interconnecting said receiver, said moduation means and said translating means, vhereby supersonic frequency acoustic wave enrgy generated in response to tapping the disant end of said member upon an unyielding surace may upon reflection from a distant object e detected as sound wave signals audible to the ıser of the aid.

2. An object locating device comprising an longated member adapted at one end thereof o be held in a user's hand and at its distant nd adapted to be placed in engagement with , nonyielding surface, a mechanical generator ›f supersonic sound wave energy mounted on aid member at its distant end, a retractible ›lunger for actuating said generator when said plunger is retracted by engaging said distant end with said surface, a directional transmitter connected to said generator for propagating the energy produced by said generator, receiving means mounted on said elongated member intermediate said generator and said hand end for receiving reflected portions of said propagated energy and translating it into electric wave energy, and means for converting said electric energy into a signal that is audible to the user of the device.

3. A portable aid for the blind comprising a pneumatically operated source of supersonic wave energy, a directional projector for said energy, a directional pick-up, means for deriving an audio frequency electric signal from the output of the pick-up, a headphone receiver actuated by the audio frequency electric signal, a cane and means for mounting said projector and pick-up units in spaced relation thereon with their axes of maximum sensitivity converging such that the pick-up unit is actuated largely by the projected waves which are reflected from obstacles in the vicinity of the user, said pneumatically operated source of energy being adapted to be actuated by the usual tapping action of the cane.

4. A portable aid for the blind comprising a pneumatically operated source of supersonic wave energy, a directional projector for said energy, a directional pick-up, means for deriving an audio frequency electric signal from the output of the pick-up, a headphone receiver actuated by the audio frequency electric signal, a cane and means for mounting said projector and pick-up units in spaced relation thereon with their axes of maximum sensitivity converging such that the pick-up unit is actuated largely by the projected waves which are reflected from obstacles in the vicinity of the user, said pneumatically operated source of energy being adapted to be actuated by the usual tapping action of the cane and said supersonic wave energy being emitted in pulses to enhance the signal-to-noise ratio.

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