Oct. 1, 1935. E. PRAETORIUS ET AL 2,015,962

ACOUSTIC SWITCH

Filed Aug. 7, 1931

Fig. 1

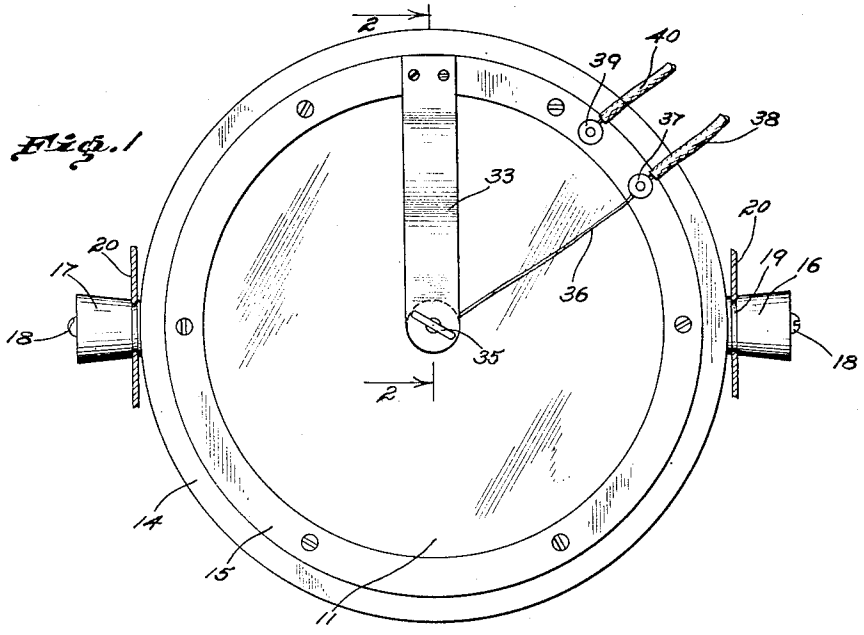


Fig. 2

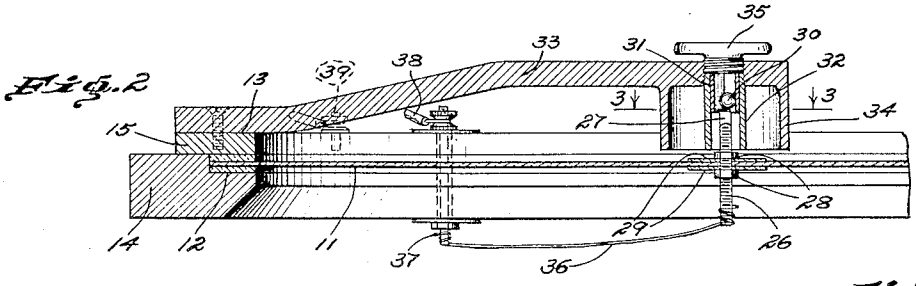


Fig. 3

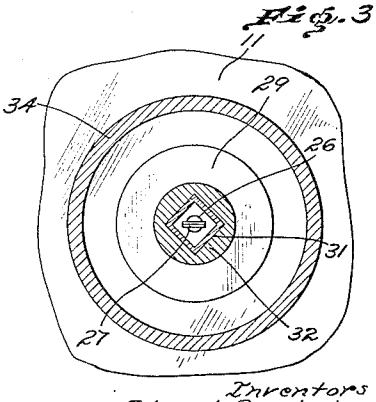
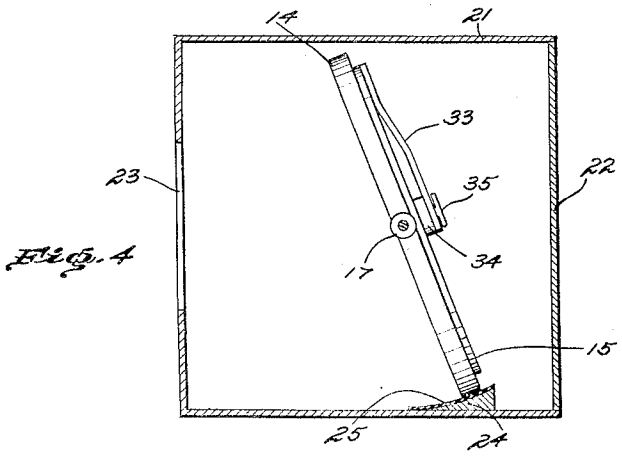


Fig. 4



Inventors
Edward Praetorius
Nathan E. Joaquin
by John F. Flam
Attorney

Patented Oct. 1, 1935 2,015,962

UNITED STATES PATENT OFFICE

2,015,962

ACOUSTIC SWITCH

Edward Praetorius and Nathan E. Joaquin, Los Angeles, Calif., assignors of one-third to John E. Stewart, Los Angeles, Calif.

Application August 7, 1931, Serial No. 555,810

7 Claims. (Cl. 200—52)

This invention relates to a circuit controlling device, and more particularly to a device that controls a circuit in response to the reception of minute elastic impulses of high frequency, such as sound waves. In its broader aspect the invention, however, can be utilized to perform a circuit control function in response to mechanical vibrations.

For example, the device can be placed in the path of sound waves, such as those emanating from an automobile horn, in order to initiate the operation of a traffic signal, or the opening or closing of a garage door. It is accordingly one of the objects of this invention to provide a switch that responds to very weak mechanical vibrations, such as those received from a horn placed even as much as a hundred feet or more from the device.

In receiving such vibrations, and in converting the energy thus received into one capable of opening or closing a circuit for an operable period, certain problems are met with which will now be discussed. Sound vibrations, for example, have a range of from about ten per second to as high as many thousands per second. If a diaphragm is placed in the path of these vibrations, this diaphragm will vibrate at the frequency received by it; but the mechanical movement is very slight and the frequency of vibration is so rapid that a contact operated thereby cannot perform a control function in ordinary circuits during any particular vibration.

It is true that by appropriate amplifiers these vibrations can be faithfully reproduced as variations in current flow; but no relay, operating a switch, can respond fast enough to control the switch. With the aid of our invention, these extremely rapid vibrations are translated into very much slower vibrations that are capable of operating such relays when the relays are properly designed. In general, the period of opening or closing of the contacts that operate the relay can be lengthened by the aid of this invention, to a very large multiple of the period of each vibration received.

We accomplish these results by providing a pair of contacts that are operated by the kinetic energy of a train of waves. We believe that our device integrates the very small energy increments of a number of succeeding vibrations, but we do not wish to restrict the scope of the invention to any theory.

Our invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of one embodiment of our invention. For this purpose we have shown a form in the drawing accompanying and forming part of the present specification. We shall now proceed to describe this form in detail, which illustrates the general principles of our invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of our invention is best defined by the appended claims.

Referring to the drawing:

Figure 1 is a front elevation of a device embodying our invention;

Fig. 2 is an enlarged sectional view taken along plane 2—2 of Fig. 1;

Fig. 3 is a further enlarged detail section, taken along plane 3—3 of Fig. 2; and

Fig. 4 is a diagrammatic view, partly in section, illustrating the manner of mounting the device.

First of all, the elastic waves propagated through the air or from any other medium is translated into mechanical motion, as by the aid of a thin diaphragm 11. This diaphragm is made from stiff material such as mica, and can have a thickness of about nine thousandths (.009) of an inch. In order that it be sensitive to weak vibrations, its exposed area can be made quite large in diameter; for example, about 8 inches.

This diaphragm is clamped at its edge between two yielding rings 12, 13, each about one-sixteenth of an inch thick and made for example from cork. The clamping is accomplished by a pair of rings 14, 15. One of these rings, such as 14, can be provided with an annular recess to accommodate the rings 12, 13 and the diaphragm 11.

In order to mount the diaphragm 11 and its supporting structure in such a manner that extraneous mechanical vibrations shall not affect it, there are provided a pair of resilient supporting projections 16, 17 on diametrically opposite sides of the ring 14. These projections can be conical and can be made from soft rubber or the like and can be held in place as by screws 18. They can be pinched, as indicated at 19, in apertures in side walls 20 of a supporting box such as 21 (Fig. 4). The projections thus permit the diaphragm structure to be angularly adjusted about the axis of these projections. Such angular adjustments may be desirable as explained hereinafter, to make the plane of diaphragm 11 assume an oblique position for causing gravity to act on the control contacts in lieu of a weak spring or the like.

The box 21 can be made from sheet metal with a removable or hinged cover 22 at the back; and

at the front, an opening 23 can be provided to permit the passage of sound waves into the box when these sound waves are properly directed. A supplemental support 24 for the lower edge of the structure can be placed inside the box, and can be provided with a layer 25 of rubber or the like.

One of the cooperating contacts operated by the vibration of diaphragm 11 can be supported at or near the center thereof. It can take the form of a threaded post 26 passing through the diaphragm, having a knife edge insert 27 at one end. This insert can be made from a noble metal to provide good conducting properties, as, for instance, of chemically pure silver, or gold or platinum. The post 26 can be held in place in the center of the diaphragm 11 by the aid of nuts 28 engaging opposite sides of the diaphragm and threaded on the post. In order to stiffen the diaphragm 11 slightly at its center, washers 29 of thin mica can be placed on opposite sides thereof.

Contact is normally made between the member 27 and a mobile electrode or contact 30. This is in the form of a ball of about one-eighth (⅛) of an inch in diameter and also made from a noble metal. This ball is urged against the contact 27 as by gravity. Its movement is restrained or guided in a square channel member 31 also made from noble metal. As shown most clearly in Fig. 3, the contact 27 is in a diagonal position with respect to the member or guide 31. Furthermore, this guide and the contact 27 are of such proportion with respect to mobile contact 30 that they cooperate to form a three-point support for the ball when the diaphragm is in the inclined position of Fig. 4.

The guide member 31 is soldered or otherwise supported in a sleeve 32 threaded into a supporting arm 33. This arm is supported on ring 15 as clearly shown in Figs. 1 and 2. A depending flange 34 overlies the sleeve 32 to shield it; and a thumb screw 35 is threaded into the outer portion of the threaded aperture in arm 33 for confining the ball 30 in the space defined by guide 31.

The operation of the device is such that the kinetic energy of the vibrating diaphragm 11 acts to separate the ball 30 intermittently from contact 27 for a substantial period. This separation of the contacts opens a circuit that may control a relay or the like. We shall now describe in detail just how this operation is effected.

With the diaphragm structure inclined as indicated in Fig. 4, and no vibrations received, it is apparent that the ball 30 is held against knife edge 27 by gravity, and that this ball is confined by the two adjacent walls of the guide 32 which slope upwardly away from the knife edge contact. When vibrations are received, the diaphragm 11 vibrates and the post 26 imparts a rapid kick to the ball 30, sending it up the inclined guide. As it rolls up the incline, the circuit is interrupted and stays interrupted until the ball rolls down the incline. The blow imparted to ball 30 is produced by the kinetic energy of the vibrating diaphragm and of post 26, which is purposely made long enough to supply the proper amount of mass to the moving system. For ensuring that the ball 30 will not roll back too quickly, the inclination of guide 31 from the horizontal is made slight, as by keeping the plane of diaphragm 11 not far from the vertical.

The period of separation of the ball 30 from contact 27 can be made very much longer by properly proportioning the arm 33. Apparently there is a definite cooperation between the natural frequency of vibration of this arm and the vibrations of the diaphragm 11. Thus the vibrations imparted to the arm 33 by the energy received by the device serve to act on ball 30 to facilitate its movement away from contact 27 or to retard its return thereto. In one form of switch we have devised, the natural frequency of the arm 33 was of the order of several hundred, and this seemed to produce the desired effect. For example, if arm 33 were made rigid as by providing a stiff brace for it, the ball 30 is not kept out of contact with member 27 for as long a period as otherwise. From observations made on an embodiment, the period of separation of ball 30 and contact 27 when the plane of diaphragm 11 is sixty-seven degrees from the horizontal is hundreds of times the period of the vibration of diaphragm 11.

When the diaphragm 11 is actuated, the ball 30 is thus thrown by kinetic energy up the guide 31 and is periodically returned. Its period of separation from contact 27 is, however, sufficient to operate a properly designed relay.

The mode of connecting the members 27, 30 into a control circuit can be provided in any appropriate fashion. For example, a lead 36 can be joined to post 26 as well as to an insulated binding post 37 supported in rings 14, 15. A lead 38 can be joined to the post from the circuit to be controlled. Another binding post 39 is grounded to the structure. Thus the other lead 40 from the controlled circuit is placed in metallic connection with the arm 33, sleeve 32, guide 31 and finally to ball 30. When ball 30 rests on contact 27, the circuit is completed from ball 30 to this contact, lead 36, post 37, to lead 38. When the ball is separated from contact 27, this circuit is interrupted thereby.

We claim:

1. In a circuit controller, a member arranged to be directly vibrated by the reception of sound waves through the air, a striker carried thereby, a mobile contact arranged to be struck by the striker, and an inclined guide for the mobile contact.

2. In a circuit controller, a member arranged to be directly vibrated by the reception of sound waves through the air, a striker carried thereby, a mobile contact arranged to be struck by the striker, and a vibratile guide along which the mobile contact moves.

3. In a circuit controller, a member arranged to be directly vibrated by the reception of sound waves through the air, a striker contact member carried thereby, a ball contact, and an inclined vibrating guide for the ball contact, the incline being upward from the striker contact member.

4. In a circuit controller, a diaphragm arranged to be directly vibrated by the reception of sound waves through the air, a striker member carried at the center thereof, an inclined guide leading upwardly from the member, a mobile contact on the guide and urged by gravity toward the striker member, and means for mounting the guide so that it can vibrate when the diaphragm is actuated.

5. In a circuit controller, a member arranged to be directly vibrated by the reception of sound waves through the air, a striker carried thereby, a mobile contact arranged to be struck by the striker, and a vibratile guide along which the mobile contact moves, the natural period of vi-

bration of the guide being of the order of several hundred per second.

6. In a circuit controller, a diaphragm arranged to be directly vibrated by the reception of sound waves through the air, clamping rings for the diaphragm adjacent the edge thereof, a post supported at the center of the diaphragm, a knife edge contact member carried by the post, a vibratile arm supported at one end on one of the clamping rings and extending substantially radially to the center of the diaphragm, a rectangular guide member carried by the arm and having an axis perpendicular to the plane of the diaphragm, said knife edge extending to the guide and arranged in diagonal relation thereto, and a ball contact supported by the guide and the knife edge.

7. In a circuit controller, a diaphragm arranged to be directly vibrated by the reception of sound waves through the air, means for supporting said diaphragm adjacent the edge thereof, a striker contact member carried by said diaphragm, a vibrating arm supported at one end on the supporting means and extending towards the striker contact member, a guide member supported on the arm over the striker contact member, and a ball contact member supported by the guide member and the striker contact member.

EDWARD PRAETORIUS.
NATHAN E. JOAQUIN.