

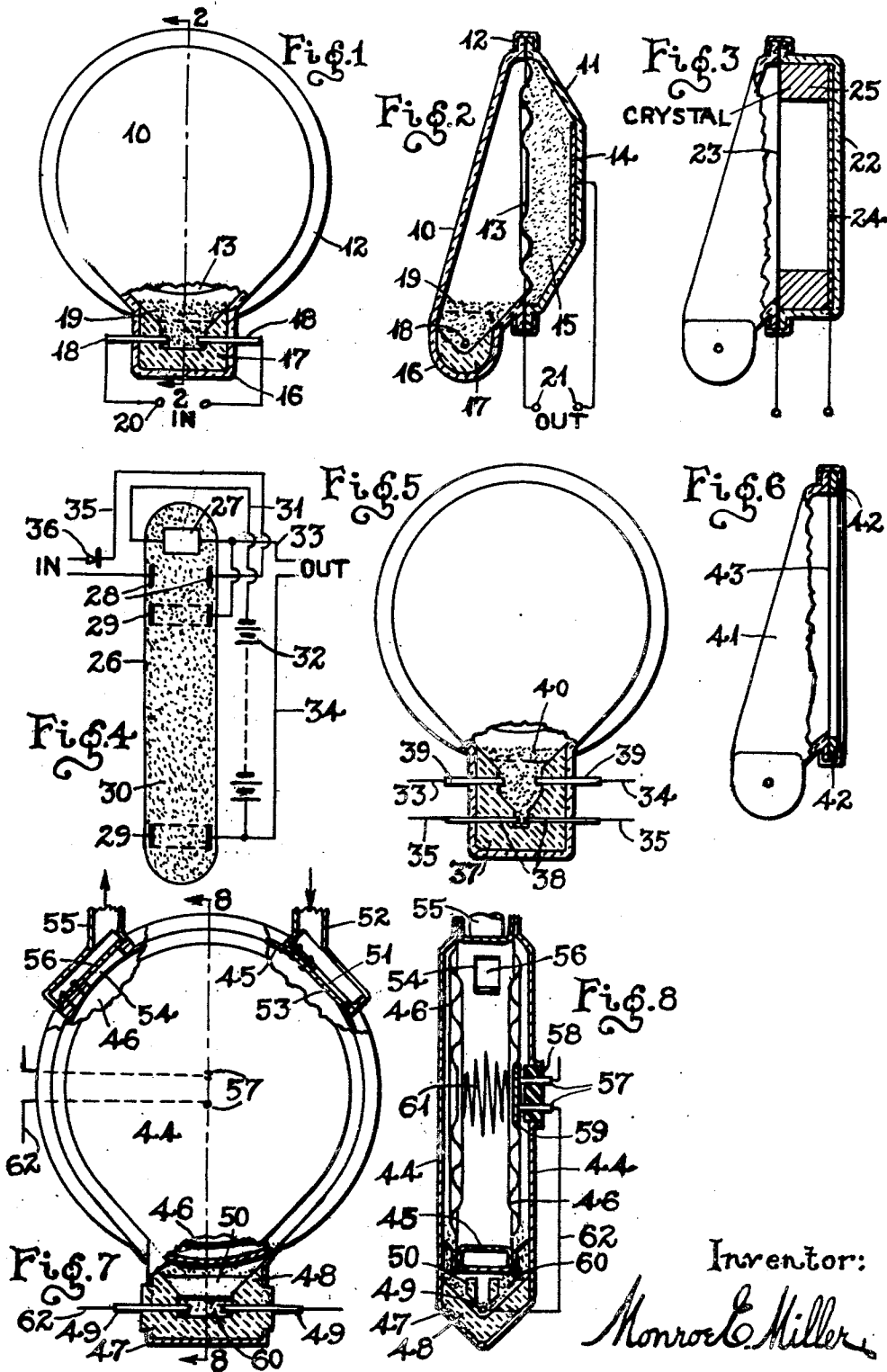
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ELECTRICAL IMPULSE DEVICE

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ELECTRICAL IMPULSE DEVICE

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This invention relates to devices by means of which electrical impulses are used for controlling, actuating or otherwise influencing a medium for the translation of the impulses, such as for amplification, sound production or motivation, and the primary object of the invention is to provide a novel device for accomplishing such results, this application being a continuation-in-part of application Ser. No. 34,293, filed June 21, 1948.

Another object is the provision of such a device which is simple, efficient and durable; which does not use a filament or other medium that is apt to break or get out of order and interrupt service; and which does not require a coil or winding for magnetic flux.

In the accompanying drawings—

Figure 1 is a rear view of one form of an electrical amplifying valve embodying the invention, portions being broken away and shown in section;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a side elevation, with portions broken away and shown in section, of such a valve with a modification;

Fig. 4 is a diagram of a different form of the invention for use in amplification;

Fig. 5 is a view corresponding with Fig. 1 showing a modification according to Fig. 4;

Fig. 6 is a view corresponding with Fig. 3 with the device adapted for use as a sound producer;

Fig. 7 is a face view of a pump embodying the invention, portions being broken away and shown in section; and

Fig. 8 is a section on the line 8—8 of Fig. 7.

The form of the invention as shown in Figs. 1 and 2 is especially suitable for amplification, that is, for producing from feeble or relatively weak impulses in one circuit stronger impulses in another circuit wherein the oscillations in intensity are in accordance with the oscillations in the first-named circuit, such a device being sometimes called an electrical valve although it can be used or regarded as a repeater.

An envelope is provided comprising the sections 10 and 11 having flanged rims fused or cemented together, or embraced by a sealing band, as at 12, with a diaphragm 13 of suitable resilient metal clamped between said rims and thus providing a flexible partition dividing the space within the envelope into two separate chambers. The envelope sections are of glass or other dielectric material. The front section 11 is dish-shaped and has secured to its inner surface opposite to the diaphragm a metal plate or disk 14, and said section is filled with loose carbon granules or powder or some other resistant conducting substance 15, to provide a variable resistance or microphone the resistance of which is decreased as the diaphragm is pressed toward the plate 14.

The rear section 10 has a lower pocket or cup

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16 in which is nested a recessed receptacle 17 of porcelain, baked clay or other refractory insulating material, and from said pocket the section 10 is flared to the diaphragm somewhat as a horn.

While the receptacle needs to be at the bottom of the envelope, and while an upright position of the diaphragm may be preferable, the diaphragm can be in an inclined position or even horizontal with the horn portion of the section 10 formed accordingly. The chamber defined by the section 10 and diaphragm is a vapor chamber, and for this purpose electrodes 18 of platinum, or other suitable metal capable of withstanding arcing, are secured in the receptacle 17 to provide a spark gap therein, and are fused or otherwise secured through the wall of the pocket 16. A suitable quantity of gas carbon or lamp black, or some other appropriate substances suitable for vaporization or as an expansive thermal medium, is provided in the vapor chamber to settle down into the receptacle 17 by gravity, as at 19, the lip of said receptacle and the surrounding portion of the envelope forming a hopper above the electrodes so the powder is delivered to them in order to be vaporized by the flow of electrons between the electrodes as an arc is produced. While a powder which sublimates into a vapor from a solid state is preferable, some other powdered solid or a liquid may be used if it is suitable, and the vapor chamber may be completely or only partly filled for best results.

Binding posts 20 are connected with the electrodes 18 for connecting them in an input circuit of relatively low voltage, and binding posts 21 are connected with the plate 14 and diaphragm 13 for connecting them in an output circuit of relatively high voltage. The size of the valve may vary with the voltages used.

In operation, electrical impulses in the input circuit produce arcing across the gap between the electrodes, as particles of the powder 19 bridge the gap in the path of electrons flowing from one electrode to the other, and this heats some of those particles in proportion to the amplitudes of the impulses, thus providing explosive puffs of gas which vibrate the diaphragm accordingly. The two chambers may be at atmospheric or higher pressure with helium, neon or other inert gas therein, or they may be at subatmospheric pressure or even vacuum, providing the normal gas pressure is balanced with the diaphragm in idle position. If a gas is used it may have a chemical affinity for the powder or other substance 19 providing that any chemical action occurring aids rather than interferes with the action as herein described. The heating of the gas increases the gas pressure on the rear side of the diaphragm so it is forced toward the plate 14, thereby compressing the resistance medium 15 accordingly and decreasing the resistance in the output circuit

in proportion. This causes impulses in the input circuit to be repeated in the output circuit and amplified by a stronger current in the latter circuit. Any explosive vaporization of carbon and other substances in an electric arc is rapid, being of very brief duration, and the vapor condenses quickly by the air cooling of the envelope, although water cooling may be used, so the present device is efficient for high frequencies of oscillations. The condensed particles of powder fall back into the lower portion of the envelope and keep particles in position to assure of proper arcing and vaporization. The diaphragm returns to its normal position as the gas cools or as condensation occurs. The operation is most efficient when the powder has become heated to a normal working temperature considerably above atmospheric temperature but not high enough to melt or ruin parts of the apparatus, so the temperature increase for vaporization of the powder need not be so large as under atmospheric temperature of the powder. The temperature of the powder and surrounding parts drops as the heat is radiated and conducted in various directions and dispersed to the atmosphere surrounding the device. The highest heat is localized between the electrodes and the normal working temperature in the spark gap may approach the vaporization point so the electrical impulses are effective for vaporizing the powder. The adjacent ends of the electrodes may be of various formations, areas and spacing, according to the current voltage of the input circuit, and the valve may otherwise conform to the conditions which apply.

With such a device there is no filament to break and interrupt service, and the valve may have a much longer life than an amplifying tube using a filament. The present valve uses no magnetic flux so a winding or coil of wire is unnecessary.

Fig. 3 illustrates the use of a cup-shaped envelope section 22, a normally-flat diaphragm 23, a metal plate 24, and an annular crystal 25, or other compressible solid of resistant material, between the diaphragm and plate, with the central portion of the diaphragm free to be sprung into the opening of the crystal so it is compressed with a leverage, thus making the crystal more sensitive than if it occupied the space between central portions of the diaphragm and plate.

The diagram of Fig. 4 corresponds with one in the aforesaid application and shows a vapor-controlled resistance type of valve wherein all the elements are enclosed within a bulb, tube or other one piece airtight dielectric envelope 26 strong enough to resist explosions therein, said elements including the resistance medium 27, a pair of laterally-spaced input electrodes 28, a pair of longitudinally-spaced booster electrodes 29, and a carbon powder or other vaporizable substance 30 filling the space within the envelope, with wire connections for the electrodes and resistance medium fused or otherwise secured through the glass or other dielectric material. This device is especially suitable for small sizes with feeble impulses in the input circuit although it can be made in larger sizes also. The medium 27 is a piezo crystal, microphone or other compressible resistance, and is completely within the envelope so as to be subject to pressure all around it, instead of only at one side as in Figs. 2 and 3. The medium or resistor 27 is of suitable size according to its characteristics and the pressures to which it is subjected, so it will function as hereinafter described. If carbon granules are

used for the medium 27 they are contained in a compressible case of suitable nonconducting or at least resistant substance which, owing to its resilience or that of the filling, will expand of itself when pressure thereon is relieved. The medium 27 is in an output circuit including a wire 31 connected with said medium and a source of direct current 32, a wire 33 connected with said medium, and a wire 34 connected with the source 32. The electrodes 28 are in the input circuit 35 which, as shown, has an electrical check valve 36 so the flow can be in one direction only. These electrodes may be of suitable form, area and spacing appropriate for the voltage of the input circuit, while the electrodes 29 may be rings or of other appropriate form, area and spacing according to the voltage of the source 32, and are connected to the wires 33 and 34 to provide a booster circuit. The envelope may contain an inert gas under atmospheric or higher pressure, or may be under subatmospheric pressure or a vacuum condition, providing the pressure internally of the medium 27 balances the pressure externally thereof so said medium is compressed and expanded as arcing between the electrodes 28 produces explosive vaporization of the powder 30.

In operation, whenever an impulse in the input circuit produces an explosive action in the envelope, current flows through the booster circuit including the source 32, wire 31, medium 27, one electrode 29, powder 30, and the other electrode 29, thus producing an explosive vaporization of greater force so as to augment the primary explosive force and compress the medium further and allow a greater amount of current to flow in the output circuit including the source 32, wire 31, medium 27 and wire 33. The explosive vaporization of the powder 30 by electrons passing between the electrodes 28, even with small force, will slightly compress the resilient resistant medium 27 so current passes through the booster circuit. This circuit responds instantly during the passing of the impulse whereby the flow of electrons between the electrodes 29 will produce an added explosive evaporation of the powder 30. The two explosions are overlapped, which causes the medium 27 to be compressed more than with the initial amount, so more current flows in the output circuit than would be the case without the use of the booster circuit. During the impulse the medium 27 is compressed by the aggregate of the two explosive forces and the current flowing in the output circuit is proportional to the aggregate pressure exerted on the medium 27. When the impulse passes on, the input circuit becomes dead and the effect is first produced between the electrodes 28. The primary explosive force comes to an end first and this relieves the pressure on the medium 27 slightly, and instantly the corresponding slight expansion of the medium 27 will increase the resistance of said medium 27 in the booster circuit. This causes the reduction in the flow of current in the booster circuit and it will quickly return to its normal condition in being unable to maintain itself, against the expansive force of the medium 27. The greater the primary explosive force is the greater will be the secondary explosive force and the flow of current in the output circuit as a result of the overlapping affect of both forces. Consequently the impulses in the output circuit are boosted. This provision for amplification can reduce the number of valves when, without the boosting electrodes, two or more valves need to

be used with the output circuit of one serving as the input circuit of another, as well known in the art. Vaporization of the powder 30, though slight, gives better results than heat only does for increasing the pressure of the gas in the envelope.

In Fig. 5 a valve of the type shown in Fig. 1 has within its receptacle 37 a pair of electrodes 38 for the input circuit 35 of Fig. 4, and a pair of booster electrodes 39 to which the wires 33 and 34 are connected, with the booster electrodes above the others and both arranged for the differences in voltages used so as to properly vaporize the substance 40. This valve may have the resistance medium of either Fig. 2 or Fig. 3, or may be used for a free diaphragm as explained presently.

Fig. 6 depicts the device of Fig. 3 without the use of the resistance medium for amplification. Between the envelope section 41 and a ring 42 secured to the rim thereof is a resilient metal diaphragm 43 which is free to produce sound waves in the atmosphere as the influenced medium, so the device can be used as a telephone receiver, loudspeaker or other sound producer. With this form of device the diaphragm 43 constitutes a portion of the envelope or chamber and an inert or other suitable gas of atmospheric pressure needs to be used in the envelope. Thus this sound producer needs no magnetic coil or winding and can be made as powerful as desired when of appropriate size.

Figs. 7 and 8 illustrate the invention as embodied in a fluid pump, so air or other fluid can be moved or motivated in a conductor therefor. This device will serve as an actuator or prime mover. A casing or envelope comprises tray-like sections 44 and an annular intermediate section 45, said sections having flanges secured together in any suitable manner, detachably if desired, with a diaphragm secured between each section 44 and the section 45, thus providing a vapor chamber between the sections 44 and diaphragms containing an inert gas and a fluid chamber between the diaphragms. The sections 44 have a pocket 47 containing a receptacle 48 of refractory insulating material provided with electrodes 49. The casing may be conveniently made of metal and the interior surfaces may be enameled or otherwise coated with insulating material as needed or desirable. The diaphragms may also be treated likewise although the insulation needs to be flexible. The receptacle 48 has a hopper-like cavity for the spark gap between the electrodes, and has spaced partitions 50 in said cavity to provide a vapor passage leading upwardly from the spark gap.

The fluid chamber has provision for the flow of air or other fluid into and out of it so the fluid can be impelled for a useful purpose. As shown the section 45 has a fluid inlet 51 for an inflow pipe or other conductor 52, with a check valve 53 for the inlet to prevent reverse flow, and said casing section has a fluid outlet 54 for an outflow pipe or other conductor 55, with a check valve 56 for the outlet to prevent reverse flow. As shown the check valves are flap valves.

In order to provide for automatic operation, a pair of electrical contacts 57 are mounted in a block of insulation 58 to be bridged by a plate or bar 59 secured to the diaphragm complementing the casing section 44 to which the block 58 is secured. The heating and possible vaporization

of the carbon powder or other substance 60 in increasing the gas pressure and forcing the diaphragms toward one another, against the pressure of a coiled spring 61 between them, opens the circuit of the electrodes with one of them connected, as by a wire 62, with one of the contacts. Thus, whenever the diaphragms are in or return to idle position, with the spring 61 assuring pressure of the bridge or switch 59 against the contacts 57, so that current flows through the circuit, an arc is produced between the electrodes and the heating or explosive vaporization of some of the powder will force the diaphragms toward one another. This expels fluid from the fluid chamber through the outlet 54 and opens the circuit at the contacts 57. The vapor is quickly cooled or condensed by air or water cooling of the casing, so fluid is drawn into the fluid chamber through the inlet 51 as the diaphragms are returned by the contraction of the vapor aided by the spring 61, and as soon as the bridge 59 is returned to the contacts another explosive action occurs and the operation is repeated. This action will be rapid as long as the casing is cooled sufficiently, and the operating temperature of the pump should not be much higher and may even be less than the temperature of an electric motor of similar power. The passage between the partitions 50 enables the vapor to pass upwardly from the spark gap so as to actuate the diaphragms as powder moves under the partitions for the next arcing action. This pump requires no wire winding or coil and no iron or other magnetic metal and even with a turbine operated by air or other fluid impelled by the pump the structure can be lighter in weight than an electric motor of the same power. Such a coupling of a turbine with the pump may be especially suitable when lightness in weight is desirable, as for automobiles and other vehicles.

Various other modifications can be made within the scope of the claims which follow.

What is claimed is:

1. An electrical impulse device comprising an envelope containing an inert gas, a loose condensed vaporizable substance therein, a pair of electrodes in said envelope providing a spark gap so arranged as to heat at least some of said substance by the flow of electrons across said gap, and an impulse-transmitting medium arranged to be affected by gas pressure in said envelope.

2. A device according to claim 1 wherein the impulse-transmitting medium is a diaphragm arranged to be flexed by said gas pressure.

3. A device according to claim 1 wherein said medium is compressible and arranged within the envelope to be compressed by said gas pressure.

4. A device according to claim 1 including a pump operated by said medium.

5. A device according to claim 1 wherein said medium is a fluid-conducting chamber having a diaphragm arranged to be flexed by said gas pressure.

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The following references are of record in the file of this patent:

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