PUBLISHED

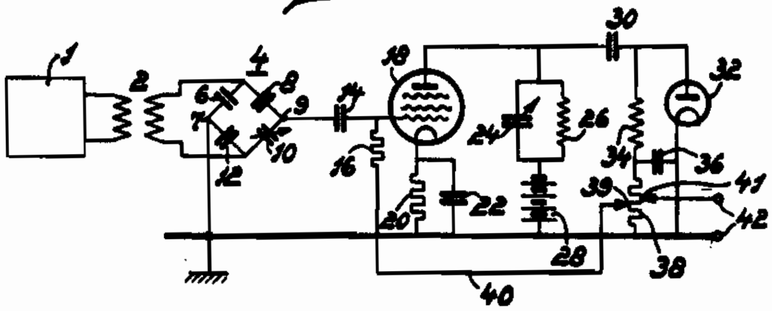
MAY 18, 1943.

BY A. P. C.

P. H. DIJKSTERHUIS
DEVICE FOR CONVERTING VARIATIONS OF A MECHANICAL QUANTITY INTO VARIATIONS OF AN ELECTRIC VOLTAGE
Filed April 9, 1941

Serial No. 387,780

Fig. 1



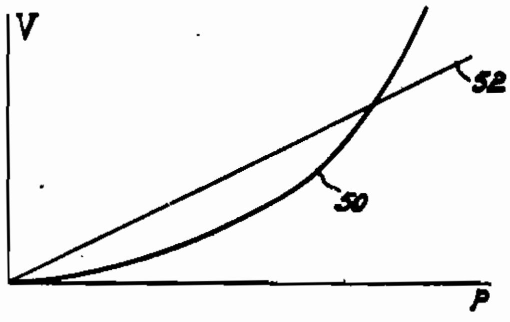


Fig. 2

INVENTOR
P. H. Dijksterhuis.
BY [signature]
ATTORNEY

Published May 18, 1943

Serial No. 387,780

ALIEN PROPERTY CUSTODIAN

DEVICE FOR CONVERTING VARIATIONS OF A MECHANICAL QUANTITY INTO VARIATIONS OF AN ELECTRIC VOLTAGE

Pieter Heertje Dijksterhuis, Eindhoven, Holland; vested in the Alien Property Custodian

Application filed April 9, 1941

This invention relates to a device for converting variations of a mechanical quantity into variations of an electric voltage by alteration of the value of an impedance under the influence of the mechanical quantity, there being a non-linear relation between the voltage across the impedance and the mechanical quantity.

The mechanical quantity may be, for example, the pressure occurring in the cylinder of an internal-combustion engine of the shape of a machine component which is subjected to variations in form or place under the influence of mechanical forces. The impedance may be constituted, for example, by an electrical resistance whose value becomes modified by variation in pressure or shape or may be constituted by a condenser in which the distance between the electrodes is dependent on the magnitude of the mechanical quantity.

Due to the absence of a linear relation between the mechanical quantity to be converted into an electric alternating voltage and the output voltage a device of the said kind is not well adapted as a measuring device. According to the invention, this disadvantage is obviated by feeding the voltage across the impedance or a voltage dependent thereon to a transmission circuit whose damping depends in such manner on the voltage supplied that the non-linear nature is balanced.

Preferably, in a device in which the variations of the mechanical quantity are converted into a modulation of a high-frequency alternating voltage by variation of the value of a condenser which is influenced by the mechanical quantity the modulated high-frequency voltage is fed to an amplifier from which a control voltage dependent on the instantaneous value of the enveloping curve of the modulated high-frequency voltage is obtained, said control voltage varying the amplification of one or more of the amplifier valves so as to ensure a linear relation between the amplified modulated high-frequency voltage and/or the low-frequency voltage obtained after detection of this voltage and the mechanical quantity, the word "damping" being here employed to define the ratio of the output voltage to the input voltage of the transmission circuit.

In order that the invention may be clearly understood and readily carried into effect it will now be set out more fully with reference to the accompanying drawing in which a preferred embodiment of the invention is diagrammatically shown by way of example.

Referring to Fig. 1, 1 designates a generator for setting up high-frequency oscillations whose output voltage is fed via a transformer 2 to a bridge connection 4 comprising four condensers 6, 8, 10 and 12. One of these condensers, for example 10, serves for converting variations of a mechanical quantity, for example variations in pressure, into variations in capacity. This condenser comprises a stationary electrode and a simple preferably plane diaphragm-shaped electrode, the latter being influenced by the variations in pressure to be converted; the flexion of the diaphragm thus brought about alters the distance between the electrodes and results in variations in capacity.

The bridge connection 4 is preferably so adjusted that if the pressure exerted on the diaphragm-shaped electrode is zero there is no voltage between the corners 7 and 9. Any increase in pressure has the effect of decreasing the distance between the electrodes of the condenser 10 and thus of increasing the capacity with the result that the corners 7 and 9 of the bridge connection have occurring between them a high-frequency voltage whose amplitude depends on the voltage across the condenser 10 and hence on the variations in pressure that occur.

The modulated high-frequency voltage between the terminals 7 and 9 is fed via a condenser 14 and a leak 16 to the control grid of an amplifier valve, for example a pentode 18, whose cathode lead includes a resistance 20 with a parallel condenser 22 for the obtainment of the negative grid bias. The anode circuit of the valve 18 includes an oscillatory circuit which comprises a condenser 24 and a coil 26 and is tuned to the frequency of the generator 1 and in addition a source of anode voltage, for example a battery 19. The anode of the valve 18 is connected to the anode of a diode 32 by the intermediary of a coupling condenser 30. The cathode of the diode 32 is earthed and the anode is connected to a load resistance 38, earthed on the other side, via a filter that arrests the high frequency oscillations. A variable tapping 39 on the resistance 38 is connected to the leak 16 via a conductor 40, whereas a second tapping 41 on the resistance 38 leads to one of the output terminals 42. The other output terminal 42 is earthed, as is also the corner 7 of the bridge connection 4.

The modulated high-frequency voltage occurring between the corners 7 and 9 of the bridge connection 4 is amplified in the transmission circuit that comprises the amplifier valve 18 and diode 32 by the valve 18 and rectified by the detector 32. The rectified output voltage whose amplitude is a measure of the variations in pressure that occur may be obtained from the terminals 42 and fed to an indicating device.

If particular precautions are not taken the characteristic curve by which the voltage V occurring between the terminals 42 is indicated as a function of a pressure *p* converted into an electric voltage has a non-linear course, as may be shown by the curve 50 of Fig. 2, with the result that the voltage V which occurs between the terminals 42 is not well adapted for measuring the absolute value of the variations in pressure that occur.

In order to balance the non-linear nature concerned which is brought about by the non-linear relation between the variation in capacity of the condenser 10, which occurs as a result of variations in pressure, and the pressure *p* a variable part of the rectified voltage, which voltage is dependent on the instantaneous value of the enveloping curve of the high-frequency voltage amplified by the tube 18, is fed as a negative bias to the control grid of the valve 18 via the tapping 39, the conductor 40 and the resistance 16. This measure has the effect of rendering the amplification of the valve 18 dependent on the supplied voltage in such manner that if the pressure *p* increases the working point on the grid-voltage anode-current characteristic curve of the valve 18 is displaced to a region of higher negative grid voltage where the mutual conductance and hence the gain is lower. Greater amplitudes of the high-frequency voltage are consequently subjected to a lower amplification. The tapping 39 on the resistance 38 permits of so varying the value of the voltage that controls the gain that the valve 18 has a complementary amplification characteristic curve of the output voltage V as a function of the input voltage V_1 so that the characteristic curve which shows the voltage V as a function of the pressure *p* is given a straight-line shape which is indicated by the curve 52 of Fig. 2.

Instead of the voltage which controls the gain of the valve 18 in accordance with the value of the high-frequency voltage fed to the valve 18 being derived from the detector 32 it may also be obtained from an independent detector which is arranged in front of the detector valve 32.

Instead of being obtained by a control of the gain as in the embodiment described, the desired characteristic curve of the transmission circuit may also be obtained otherwise, for example by a suitable choice of the valve characteristics.

PIETER HEERTJE DIJKSTERHUIS.