

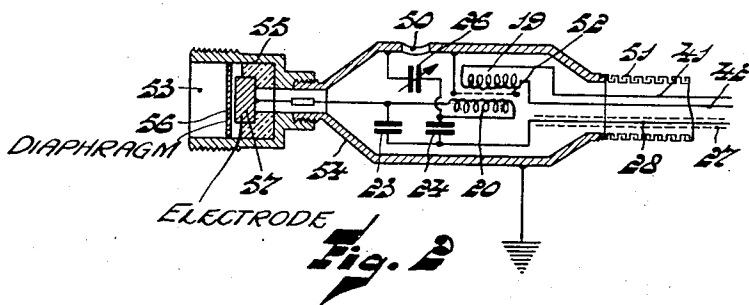
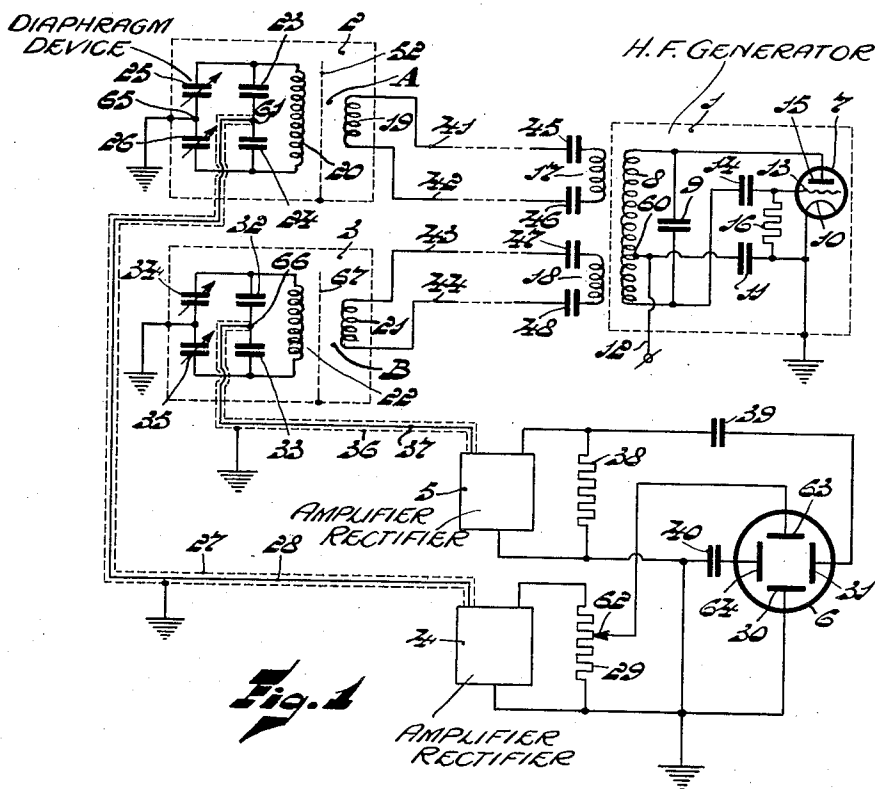
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DEVICE FOR OSCILLOGRAPHING

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DEVICE FOR OSCILLOGRAPHING

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5 Claims. (Cl. 171-95)

My invention relates to a device for oscillographing variable electric or mechanical quantities.

The U. S. patent application Serial No. 182,028, filed December 27, 1937, of which I am a co-inventor, describes a method and device for oscillographing electric or mechanical quantities in which the variations in these quantities modulate a high-frequency generator, for instance by producing changes in an impedance. In a particularly advantageous form of construction of such a device, the variable impedance forms part of a bridge having one diagonal connected to the high-frequency generator, and another diagonal from which modulated high-frequency oscillations are taken off, amplified and rectified to produce rectified currents which are used to control a measuring device or oscillograph. The variable impedance, which is preferably a capacity, is located at the "measuring point," i. e. the point at which the quantities to be measured occur, and is connected through one or more connecting leads to the "indicating point," i. e. the point at which the high-frequency generator and the remainder of the bridge are located.

With such devices it is possible to compare two quantities which are in time-relation with each other. For example, the indicator-diagram of a steam engine can be obtained by using the pressure variations in the cylinder to vary a capacity whose value controls the ordinates, and by periodically varying a second capacity in accordance with the displacement of the piston to produce the abscissae. Although the variable capacities may be very small and the bridge arrangement makes it possible to use extremely small condensers for this purpose, the device described in the above application has the drawback that the connecting leads between the variable capacities and the remainder of the apparatus have capacities which are comparatively high and in many cases are variable. This reduces the sensitivity of the device and renders the reading on the measuring device less reliable.

The object of the present invention is to overcome the above drawback, and for this purpose I construct the bridge as a unit; i. e. so that the variable impedance is not spacially separated from the remaining parts. Thus, the separation between the parts of the device at the "measuring point" and at the "indicating point" takes place between the bridge and the high-frequency generator.

The variable impedance may be connected to the remainder of the bridge through very short conductors, and a supply conductor of any desired length may be used between this bridge and the parts at the "indicating point" without deleteriously affecting the operation of the device. This supply conductor for the high-frequency os-

cillations is preferably constructed as a two-conductor cable, and it is preferably inductively coupled to the high-frequency generator or to the measuring bridge, or to both.

Preferably two bridges fed from a common high-frequency generator, are provided, one for each of the two coordinates of the diagram to be produced, and each individual bridge is constructed as a unit. As a result the device is independent—as regards the electric magnitude determined by time—of the disturbing capacity effect of the connecting leads.

In order that the invention may be clearly understood and readily carried into effect, I shall describe the same in more detail with reference to the accompanying drawing, in which:

Figure 1 is a schematic wiring diagram of an oscillographing device according to the invention, and

Fig. 2 is a sectionized and partly-schematic view of a measuring-bridge device.

The device shown in Fig. 1 comprises a shielded high-frequency generator 1, two measuring bridges 2 and 3, two amplifier-rectifier units 4 and 5 which may be of one or more stages, and a Braun-tube 6 having two pairs of deflecting plates 30-63 and 31-64. The required supply devices for the anode voltage, grid bias, and the heating current, as well as the structural details of units 4 and 5, have been omitted from the drawing for clarity.

High-frequency generator 1 comprises a triode 7 having an incandescent cathode 10, a control grid 13, and an anode 15, and an oscillatory circuit comprising a coil 8 and a condenser 9. Cathode 10 is connected through a condenser 11 to a point 60 on coil 8 and to a lead 12 to which the anode voltage is applied, and grid 13 is connected through a condenser 14 to one end of coil 8 whose other end is connected to the anode 15. A resistance 16 connected between grid 13 and cathode 10 serves to determine the average grid potential.

Inductively coupled with coil 8 are two high-frequency coils 17 and 18. Coil 17 has its ends connected through condensers 45 and 46, and supply conductors 41 and 42 to a winding 19 of a high-frequency transformer A having a second winding 20. Similarly, coil 18 has its ends connected through condensers 47 and 48 and supply conductors 43 and 44 to the ends of a winding 21 of a high-frequency transformer B having a second winding 22.

Measuring bridge 2 comprises two fixed condensers 23 and 24, which form two adjoining sides of a bridge-quadrangle and are connected in series across winding 20. Connected in parallel with the series connection of condensers 23 and 24 are two variable condensers 25 and 26 whose connecting point 55 has a fixed potential,

preferably grounded as shown. Condenser 25 serves as the impedance which is influenced by the variations to be recorded, and condenser 26 is made variable in order to allow the working point of the bridge to be adjusted. The connecting point 61 between condensers 23 and 24 is connected to amplifier-rectifier 4 through a conductor 28, which is electrostatically shielded by a sleeve 27 having a fixed potential. As shown, it is grounded.

In the state of rest, i. e. when the capacity of condenser 25 is not being varied, a high-frequency current, which has larger or smaller value depending upon the adjustment of condenser 26, flows through conductor 28 to amplifier-rectifier 4. When the capacity of condenser 25 is altered by the quantities to be measured, for instance by the variations in the pressure within an internal combustion engine or by vibrations in a building construction, the change in capacity modulates the high-frequency current flowing in the conductor 28 and these modulated oscillations are amplified and rectified by unit 4. The resulting pulsatory direct current passes through a resistance 29, which has one end connected to deflecting plate 30 of the Braun-tube 6 and a tap 62 connected to the opposite plate 63 to thereby apply across these plates a voltage which varies in accordance with the variations in the capacity of condenser 25.

To the other pair of plates 31 and 64 may be applied any desired "saw tooth" voltage, or an alternating voltage in synchronism with the quantity to be measured as is the case in the present instance. The measuring bridge 3 serves this purpose and consists of two fixed condensers 32 and 33 connected in series across winding 22, and two variable condensers 34 and 35. The connecting point 66 between condensers 32 and 33 is connected to the amplifier-rectifier 5 through a conductor 37 provided with a grounded sleeve 36. This bridge operates similarly to bridge 2, and the capacity of condenser 34 is controlled, for instance, by the shaft of the motor whose pressure is being measured, in such a manner that it varies sinusoidally with time between two definite values. As a result the amplitude of the high-frequency voltage set up between ground and conductor 37 is varied depending on the position of the rotating shaft of the motor under test, and amplifier-rectifier 5 produces a pulsatory direct current which flows through a resistance 38 whose ends are connected through condensers 39 and 40 to plates 31 and 64 of tube 6. As a result there is applied across plates 31 and 64 an alternating voltage which varies in accordance with the capacity of condenser 34.

When there is no potential difference applied across plates 30 and 63, this alternating voltage causes the luminous spot on the fluorescent screen of the Braun-tube to reciprocate in synchronism with the rotation of the motor being tested. When the potential variations are applied across plates 30 and 63, which variations are functions of the pressure in the cylinder, the spot is caused to also move between these plates, and as a result the desired indicator diagram is produced on the luminous screen of the Braun-tube 6.

In accordance with the present invention, variable condenser 25, together with the remainder of the measuring bridge 2, is formed as a unit and is located at the "measuring point," i. e. at the engine, when recording an indicator diagram. The condenser 25 may, for instance, be

constructed as a diaphragm-system of a pressure cartridge, and the remainder of the bridge together with the high-frequency transformer A, is assembled together with this pressure-cartridge to form a unit which is connected through supply leads 41 and 42 to generator 1.

Supply leads 41 and 42 may be of any desired length so that the "indicating point" may be arranged at some distance from the "measuring point," for instance on a control board. As the capacity of these leads with respect to ground, or their mutual capacity is not in parallel with the variable capacity of the condenser 25, the percentage-variations of the capacity of the condenser 25 are much larger than they would be if this condenser were connected through long leads to a bridge located at the "indicating point," because in the latter case the capacity of the leads would be in parallel with the capacity of the modulating condenser. Furthermore, the accuracy of the oscillographs can no longer be disturbed by variations in the capacity of these leads. The same applies for the ordinates determined by time, if the measuring bridge 3 is formed as a unit located at the driving point and is connected through supply leads 43 and 44 to the generator 1. The working of the unit 3 on the amplitude of the ordinates on the screen of tube 6 does not depend on the length of supply leads 43 and 44.

Condensers 45, 46, 47 and 48 have impedances which are so related to that of the leads 41, 42, 43, and 44 and of the coupling coils 17, 18, 19 and 21 that the system obtained is tuned to the oscillations to be transmitted. Because of this any harmonic oscillations produced by generator 1 are prevented from interfering with the operation of the Braun-tube.

As the tuned system of the double conductor 41—42 is inductively coupled to bridge 2 and generator 1, the bridge is as independent as possible of the capacity of these conductors and of the generator parts. For the same purpose, and to insure that oscillations can only be transmitted inductively to the bridge, electro-static screening means 52 and 67, which are maintained at fixed potentials, are interposed between windings 19—20 and 21—22 respectively of the high-frequency transformers A and B. This entirely avoids a capacitative coupling which would have a disturbing influence and facilitate the passage of higher harmonics, and as a result the zero-point of the bridge can be more sharply adjusted.

Furthermore, it is advantageous not to provide the tuning capacity of the systems comprising conductors 41—42 and conductors 43—44 in only one of the conductors of each system, but to distribute them symmetrically in the two conductors. In this manner the current in the two conductors of each system is equal, and the double conductors 41—42 and 43—44 will not have an inductive effect on the measuring leads 28 and 37 to thereby affect the accuracy of the indication of the measuring device.

The tuning condensers 26 and 35, which as stated are made variable in order that the zero-point of the bridges may be adjusted at will, should preferably be given a capacity which is small with respect to the self-capacity of the leads 41, 42, 43 and 44, so that the latter will affect the tuning as little as possible, and the amplitude of the high-frequency transmitted will be substantially independent of random capacity variations of these leads. When conductor 28 is

currentless in the position of rest, the deviation of the luminous spot on the screen of the Brauntube always has the same direction. When the bridge does not operate at the zero-point the amplitude of the high-frequency current caused by variations in the capacity of the condenser increases in one direction and decreases in the opposite direction so that the deviation on the luminous screen may occur in two directions, which is desirable for recording pressure-diagrams including vacuum measurements.

Fig. 2 illustrated the construction of a pressure-cartridge device for recording indicator-diagrams by means of the apparatus shown in Fig. 1. This device comprises a metal member 55 screwed onto the end of a grounded housing 54 and having a cavities end adapted to be screwed into an opening in the cylinder head of an engine (not shown). A flexible diaphragm 56 is secured within a cavity 53 in the member 55 and constitutes one condenser plate, which may be moved by the pressure of the gas within the cylinder relative to a fixed plate 57 mounted in an insulated manner at the bottom of cavity 53. Plates 56 and 57 act as the condenser 25 of Fig. 1, and the remaining parts of the bridge 2 of Fig. 1 are indicated in Fig. 2 by the reference numerals used in Fig. 1. It will be noted that condensers 23, 24, and 26, as well as the high-frequency transformer A are located within the housing 50 to form a unit with condenser 56—57. The three leads 41, 42, and 28 of Fig. 1 pass through a grounded flexible metal tube 51 which leads to the "indicating point".

The wall of housing 54 is provided with an aperture 50 which serves to allow the zero-point of condenser 26 to be adjusted by means of a key or a screw driver.

The measuring bridge 3 of Fig. 1 may be constructed in a unit in a similar manner with the leads 43, 44 and 37 passing through a grounded flexible metal tube to the "indicating point".

While I have described my invention in connection with specific examples and embodiments, I do not wish to be limited thereto, but desire the appended claims to be construed as broadly as permissible in view of the prior art.

What I claim is:

1. A device for oscillographing variable quantities occurring at a measuring point comprising means disposed at some distance from the measuring point for generating high-frequency current, means disposed at the measuring point for modulating said current in accordance with the quantities to be measured and comprising an A. C. bridge arrangement having an impedance adapted to be varied in accordance with said quantities, a two-conductor cable of considerable length connecting one diagonal of said bridge to said generating means, means to tune said cable to the high-frequency oscillations to be transmitted, an oscillograph, and demodulating means connected between the other diagonal of said bridge arrangement and the oscillograph to apply to said oscillograph a controlling voltage which varies in accordance with the quantities being measured.

2. A device for oscillographing variable quantities occurring at a measuring point comprising means disposed at some distance from the measuring point for generating high-frequency current, means disposed at the measuring point for modulating said current in accordance with the quantities to be measured and comprising an A. C. bridge arrangement having an impedance

adapted to be varied in accordance with said quantities, a two-conductor cable of considerable length connected between one diagonal of said bridge and said generating means, means to inductively couple said cable to the generator, means to tune the cable to the frequency of the oscillations to be transmitted, an oscillograph, and modulating means connected between the other diagonal of the bridge and said oscillograph to apply to the oscillograph a controlling voltage which varies in accordance with the quantities being measured.

3. A device for oscillographing variable quantities occurring at a measuring point comprising means disposed at some distance from the measuring point for generating high-frequency current, means disposed at the measuring point for modulating said current in accordance with the quantities to be measured and comprising an A. C. bridge arrangement having an impedance to be varied in accordance with said quantities, a high-frequency transformer having a winding connected across one diagonal of the bridge and a second winding, means electrostatically shielding said windings from each other, a two-conductor cable of considerable length connected between the second winding and said generating means, means to tune said cable to the frequency to be transmitted, an oscillograph, and demodulating means connected between the other diagonal of the bridge and said oscillograph to apply to the oscillograph a controlling voltage which varies in accordance with said quantities.

4. A device for oscillographing variable quantities occurring at a measuring point comprising means disposed at some distance from the measuring point for generating high-frequency current, means disposed at the measuring point for modulating said current in accordance with the quantities to be measured and comprising an A. C. bridge arrangement having an impedance adapted to be varied in accordance with said quantities, a two-conductor cable of considerable length connected between one diagonal of said bridge and said generating means, means to tune said cable to the frequency to be transmitted comprising two condensers of equal capacity, one in each conductor, an oscillograph, and modulating means connected between the other diagonal of the bridge and said oscillograph to apply to said oscillograph a controlling voltage which varies in accordance with the quantities being measured.

5. A device for oscillographing variable quantities occurring at a measuring point comprising means disposed at some distance from the measuring point for generating high-frequency current, means disposed at said measuring point for modulating said current in accordance with the quantities to be measured and comprising an A. C. bridge arrangement having an impedance adapted to be varied in accordance with said quantities, a two conductor cable of considerable length connecting one diagonal of said bridge to said generating means, means to tune said cable to the frequency of the oscillations to be transmitted including an impedance in each conductor, said impedances having a value which is small with respect to the self-capacity of the cable, an oscillograph, and modulating means connected between the other diagonal of said bridge and said oscillograph to apply to the oscillograph a controlling voltage which varies in accordance with said quantities.

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