

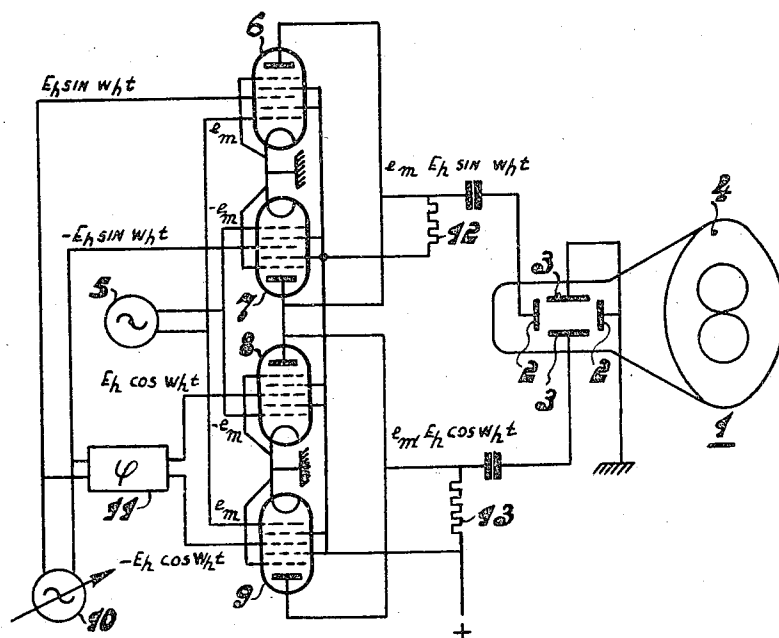
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OSCILLOGRAPH COMPRISING A CATHODE-RAY TUBE

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OSCILLOGRAPH COMPRISING A CATHODE-
RAY TUBE

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2 Claims. (Cl. 315-24)

1

This invention relates to an oscillograph for re-producing a measuring signal in polar coordinates.

It is well-known to utilize for this purpose a cathode-ray tube of the usual type comprising two pairs of deflecting plates active in directions normal to each other, use being made of two auxiliary voltages of equal amplitude which are dephased by 90° and whose frequency is in harmonic relation to the frequency of the measuring signal.

However, the polar oscillograms obtained with known devices of this kind have several practical drawbacks.

The present invention starts from the recognition that these drawbacks are due to the fact that with the known devices in the absence of a measuring signal the cathode-ray beam registers on the screen of the cathode-ray tube a circle (zero circle) having a diameter dependent upon the amplitude of the auxiliary signals. The shape of the polar oscillogram obtained thus differs from the usual shape, it being rendered difficult to carry out quantitative measurements.

According to the invention, in the polar projection of a measuring voltage e_m with the use of a cathode-ray tube of the usual type and two auxiliary signals $E_h \cos \omega t$ and $E_h \sin \omega t$ phase displaced by 90° , these drawbacks are obviated by controlling the electron beam in the two directions of deflection so as to be proportional to the products $e_m E_h \sin \omega t$ and $e_m E_h \cos \omega t$.

The product terms mentioned may be obtained, for example, by mixing one of the auxiliary signals and the measuring signal with the aid of a hexode mixing tube. In this case, however, in addition to the voltages desired, there occur components in the output circuit of the mixing tube, which are proportional to only one of the voltages supplied to the mixing tube and which give rise to disturbances in the oscillogram.

The latter drawback may be obviated by utilizing the advantageous form of construction, shown in the figure, of a device according to the invention, in which use is made of push-pull mixing stages.

In the figure, 1 indicates a cathode-ray tube comprising pairs of deflecting plates 2 and 3 for deflecting the cathode-ray beam produced by a system (not shown) in two directions normal to each other. The measuring voltage e_m to be projected on the screen 4 is taken from a source 5 of measuring voltage and supplied in push-pull in the illustrated manner to the first control grids of the hexode tubes 6, 7 and 8, 9 of two push-

2

pull mixing stages. The second control grids of the tubes 6, 7 of the one push-pull mixing stage have supplied to them in push-pull an auxiliary voltage $E_h \sin \omega t$ which is taken from an auxiliary voltage generator 10 of adjustable frequency, whereas the second control grids of the tubes 8, 9 of the other mixing stage have supplied to them an auxiliary voltage $E_h \cos \omega t$ which is phase displaced by 90° and which is taken from the auxiliary-voltage generator through the intermediary of a phase-shifting network 11.

Since the tubes 6, 7 and the tubes 8, 9 have common output resistances 12 and 13 respectively, there appear at these resistances at first approximation solely alternating voltages which are proportional to the products $e_m E_h \sin \omega t$ and $e_m E_h \cos \omega t$ respectively. The first of these components is supplied to the horizontal deflecting plates 2 and the latter to the vertical deflecting plates 3. The measuring voltage is thus reproduced in polar coordinates, and this in such manner that, only if $e_m = 0$, the cathode-ray beam impinges upon the centre of screen 4, or upon the zero of coordinates.

Now, this involves that, if a crossing occurs on the screen (see figure), which is the case if the measuring voltage passes at least twice per period of the auxiliary voltage through zero. It is sure that the point of intersection indicates the zero of coordinates, so that special auxiliary devices such as are necessary with the devices mentioned in the preamble for making the zero circle perceptible, can be dispensed with.

Moreover, due to the absence of a zero circle there exists a particularly simple relation between the radial deflection of the cathode-ray beam and the instantaneous value of the amplitude of the measuring signal. This latter and the previous property considerably facilitate quantitative measurements.

In the circuit of the mixing stages shown in the figure, there can appear at the pairs of deflecting plates even harmonics of the input signals at the deflecting plates, chiefly the second harmonics playing a part in practice.

If necessary this may be considered by means of a suitable choice of the mixing tubes used. It has been found that the 7 ECH HO 92 is advantageous in this respect, since in this tube the anode current and the cathode current are in substantially linear relation with the voltage set up at the first control grid.

What I claim is:

1. A system for scanning a measuring signal in polar coordinates with a cathode ray tube, com-

3

prising a signal source for deriving a measuring signal voltage e_m , means to derive a first auxiliary voltage $E_h \sin \omega t$, means to derive a second auxiliary voltage $E_h \cos \omega t$ phase displaced approximately 90° from said first voltage, means to combine said measuring signal voltage and said first auxiliary voltage to produce a first modulation voltage $e_m E_h \sin \omega t$, means to combine said measuring signal voltage and said second auxiliary voltage to produce a second modulation voltage $e_m E_h \cos \omega t$, two sets of electrodes in said cathode ray tube for controlling a beam of electrons in perpendicular directions, means to apply said first modulation voltage to one set of said electrodes for deflecting the beam of electrons in one direction proportional to this modulating voltage, and means to apply said second modulation voltage to the second set of electrodes for deflecting the beam of electrons in the other direction proportional to the second modulating voltage.

2. A system for scanning a measuring signal in polar coordinates with a cathode ray tube as claimed in claim 1 in which the measuring signal voltage e_m is applied to an amplifier stage

4

comprising two push-pull mixer amplifiers, each of said amplifiers comprising two electron discharge tubes having a plurality of control electrodes and the signal voltage e_m being applied to a control electrode in each tube, the first voltage $E_h \sin \omega t$ being applied to one of said amplifiers on a control grid of each tube of said first amplifier, the second voltage $E_h \cos \omega t$ being applied to other of said amplifiers on the control grid of each tube of said second amplifier, said amplifiers connected in push-pull at their input and connected in parallel at their output.

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