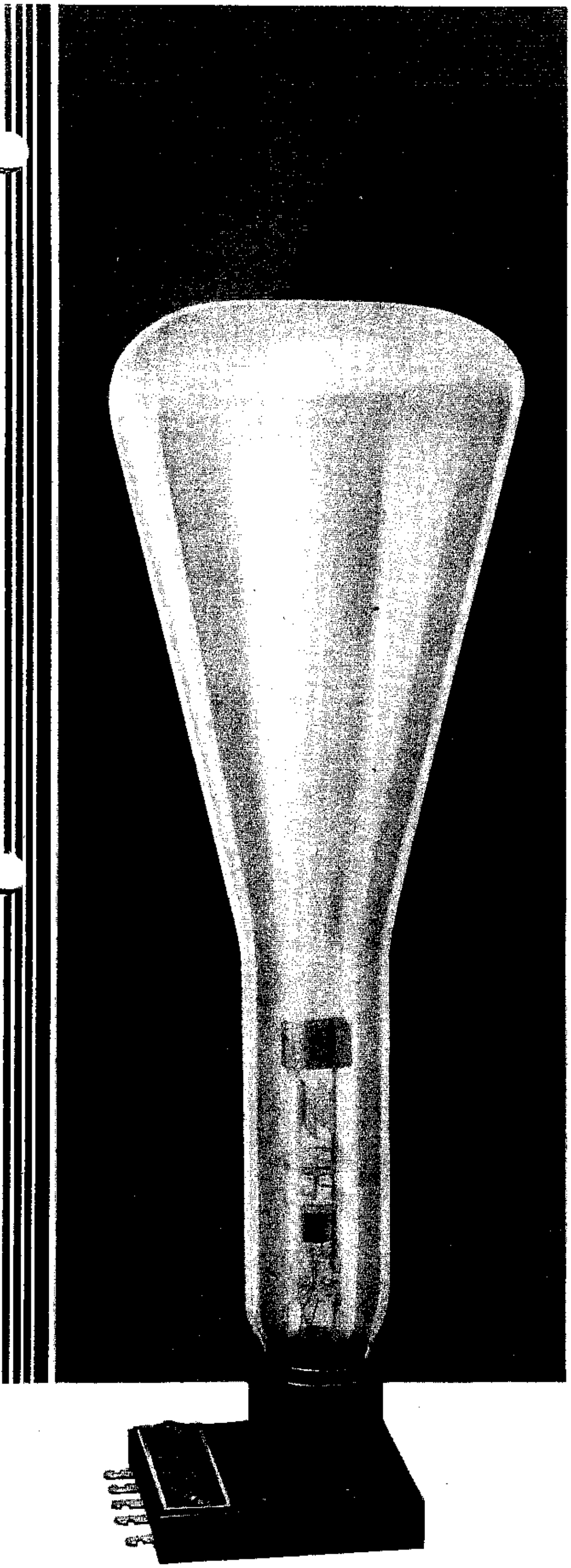
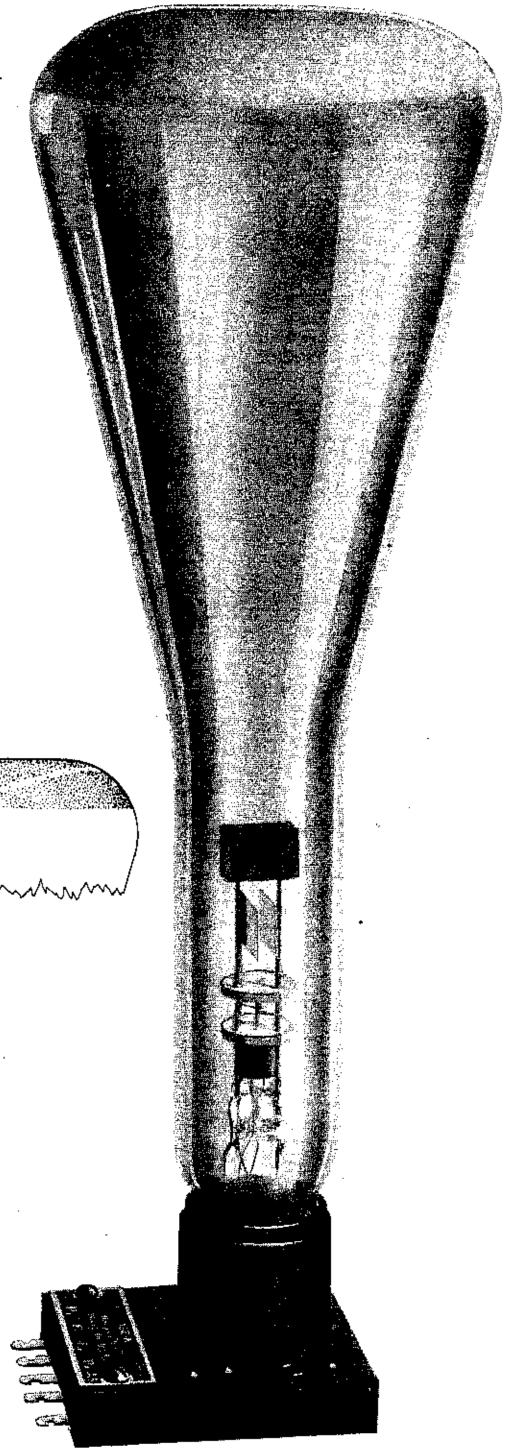


Cathode Ray Oscillograph



No. 224C Vacuum Tube in No. 122A Vacuum Tube Socket.
Drawing shows shape of viewing end of tube.

Western Electric

Cathode Ray Oscillograph

(No. 224C Vacuum Tube)

A development of Bell Telephone Laboratories, the research laboratories of the American Telephone and Telegraph Company and the Western Electric Company

THE WESTERN ELECTRIC COMPANY announces a new Cathode Ray Oscillograph Tube (No. 224C), which is intended for use by the scientific investigator.

Description

The new tube, like its predecessors, the Nos. 224A and 224B, which it replaces and with which it is interchangeable, is a low potential Cathode Ray Tube of the hot filament type. It is stable in operation and the supplementary apparatus required is simple, inexpensive, and not hazardous to use.

Many New and Valuable Features

A number of improvements give the new tube increased usefulness and durability; a fluorescent viewing screen of cylindrical section being the most significant. The screen is bright, highly visible and photographically active. In addition, since the viewing end of the tube is a cylindrical instead of spherical section, a photographic film placed on this surface lies in contact with the glass at all points. The photograph obtained by this procedure is uniform in intensity and definite in outline, a result virtually impossible with the conventional Cathode Ray Tube of spherical or parabolic section screen.

The internal structure of the new tube embodies several improvements which give it increased strength and simplicity.

Theory of Operation

The Western Electric Cathode Ray Oscillograph Tube employs a beam of electrons as its moving element. The beam of electrons is produced by an oxide coated platinum filament cathode which is encased in a small cylindrical metal chamber and heated by a six volt storage battery. Upon leaving the filament, electrons pass through a small aperture at the top of the cylindrical chamber which concentrates them into a thin stream so that they may pass through the tubular anode. The anode is kept at a potential of 300 volts positive to the filament by a battery of dry cells.

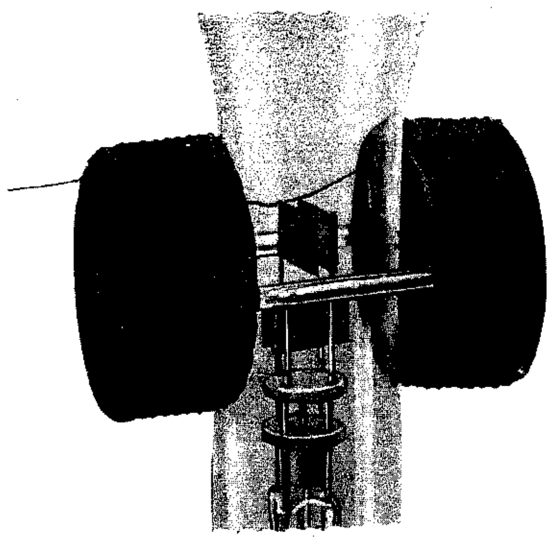
Of the electrons in this concentrated stream, the greater number strike the inside of the tubular anode. However, a small number of them pass through the anode as a thin pencil of cathode rays which strikes the fluorescent screen at the opposite end of the tube.

After leaving the tubular anode, the electrons pass between two pairs of deflector plates on their way to the viewing screen. These plates are supported by heavy wires which are anchored firmly in the glass of the stem and held rigidly by lavite reenforcements. The plates of each pair are parallel and the two pairs are at right angles to each other.

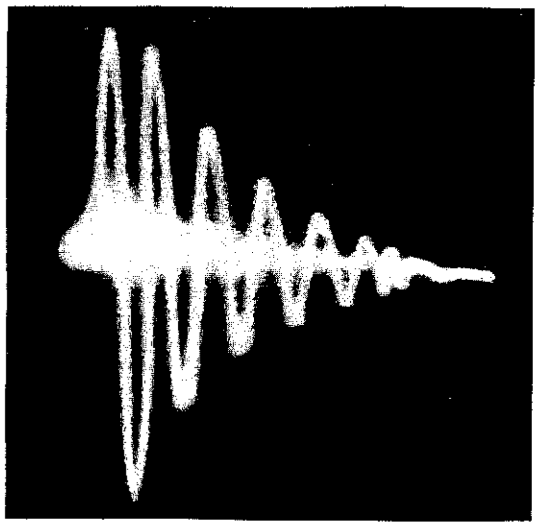
When the tube is in use, the electron stream in passing between the plates of the first pair is deflected toward the positive plate of that pair. The amount of deflection depends upon the momentary electric field set up by the potential difference between the plates. A second deflection at right angles occurs when the other pair of plates is reached.

The result is that at any instant the recording point forming the end of the stream occupies a position on the viewing screen which, both in direction and distance from its normal position at the center, is a resultant of the deflecting forces due to the differences of potential acting at that instant on the two pairs of plates.

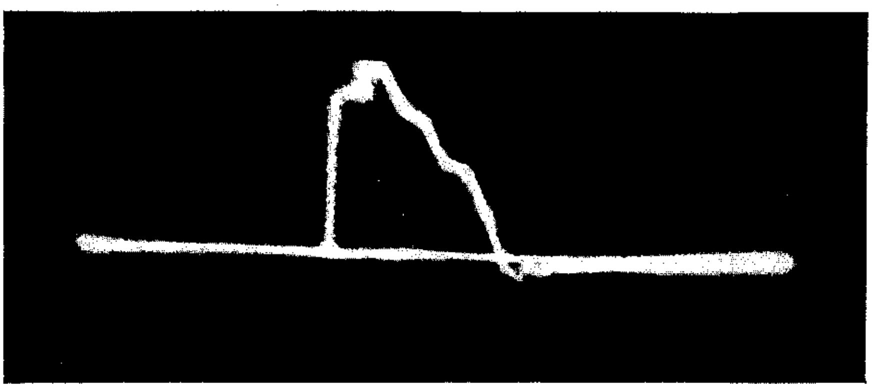
In addition to its deflection by an electric field, the electron stream may be deflected by a magnetic field. This is done by using a permanent magnet, electro-magnet or a pair of coils, in which current is flowing, outside the tube. When these coils are four centimeters in diameter they produce a deflection of the recording point of approximately one millimeter per ampere turn.



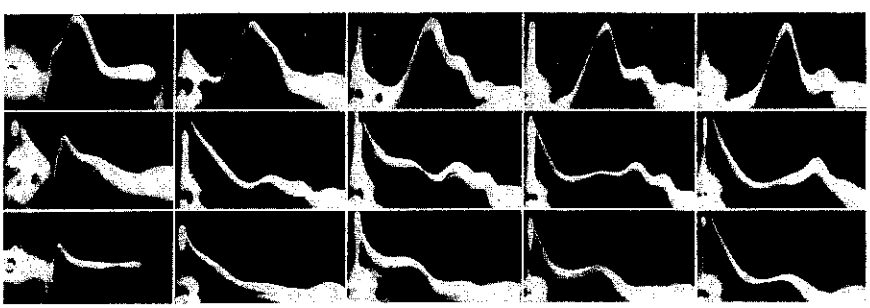
The No. 224C Vacuum Tube with Coils for Magnetic Deflection.



Discharge of condenser through inductance.



Discharge of condenser through chattering contact.



Action current of a stimulated frog nerve.

Patterns as they appear on the Oscillograph Screen.
(from photographs)

Capabilities

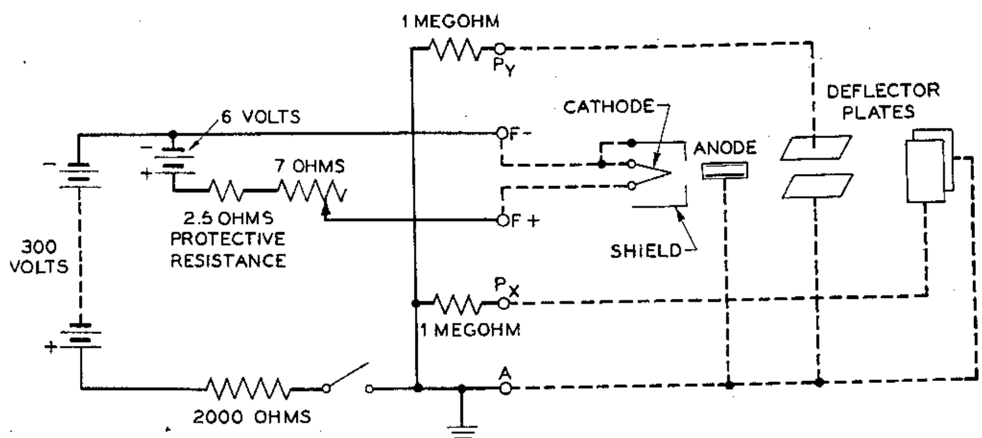
The Cathode Ray Oscillograph Tube is the most direct means for showing graphically electrical oscillations of the higher frequencies, and for accurate determination of electrical synchronization and frequency ratios. It is the only known commercial device with which the curves of hysteresis and dielectric losses can be plotted directly. With it the characteristics of apparatus producing fluctuating electric potential, currents or magnetic fields can be plotted against each other.

The No. 224C Vacuum Tube is practically free from inertia and resonance effects due to the fact that the moving element consists of a beam of electrons. Therefore, it is possible with this tube to study extremely high frequency variations. This feature makes the tube the recognized instrument for use in studying the behavior of a great variety of oscillatory and periodic electrical phenomena.

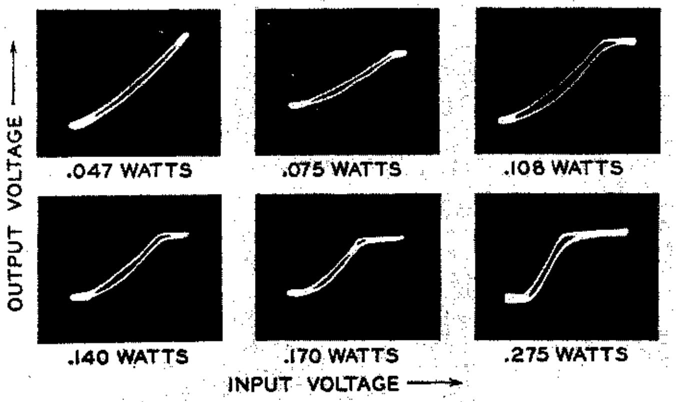
By means of the No. 224C Vacuum Tube, it is possible to obtain accurate graphic representations for determining and measuring, regardless of frequency, the performance characteristics of electrical apparatus, and also of mechanical apparatus which is capable of affecting an electrical circuit by its motion.

With this tube the electro-magnetic properties of materials can be determined, and the relation between any two of these characteristics or properties may be shown instantly.

Due to the practical absence of inertia, the tube may be used in general work for frequencies up to several hundreds of thousands of cycles per second. Where a sharp pattern is not required, the tube may be used, in some instances, for frequencies as high as many millions of cycles per second.

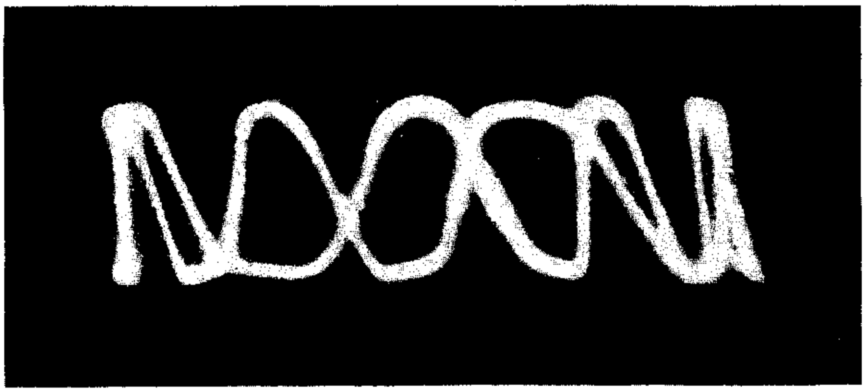


Basic Circuit Diagram for the No. 224C Vacuum Tube.



Distortion in vacuum tube amplifier.

Hysteresis curves (A) of iron, (B) of permalloy.



Frequency comparison. Ratio 8:1.

Patterns as they appear on the Oscillograph Screen.
(from photographs)—continued from page 5

Applications

The No. 224C Cathode Ray Oscillograph Tube has a large number of applications. Its field of possible usefulness never has been fully explored. A few suggestions are given here to indicate the possibilities. In the appendix will be found a bibliography, giving a list of works from which exhaustive treatment of a number of specific applications may be obtained.

Research

In electrical laboratories, both commercial and those devoted solely to the interest of science, the Cathode Ray Oscillograph may be used for the detection of transient currents; for determining magnetic and dielectric properties of materials; for the study of:

- Alternating currents and electrical oscillations
- Corona discharge
- Electrical and mechanical synchronization
- Comparisons of inductances and capacities
- Current and voltage
- Insulation efficiency
- Performance of vacuum tubes
- Induction coils
- X-ray tubes

In physical laboratories the tube has a wide application in the electrical studies already mentioned and for studying speech and other sound characteristics.

In physiological laboratories it is invaluable for studying nerve reaction and other electrical phenomena associated with the physiological processes.

Education

This tube may be used for classroom demonstrations of current voltage reactions, alternating current characteristics, oscillating discharges, hysteresis, sound and speech characteristics; for laboratory experimental work in comparisons of inductances, capacities and resistances and the effect of their combination in electric circuits.

Testing

It may be used for locating trouble in electric circuits and for the measurement and adjustment of modulation in radio transmitters.

Summary

The fact that the instrument plots in rectangular coordinates insures ease of interpretation of the results, whether visual or photographic.

Two features, lack of inertia and capacity for double control, in combination, with other advantages in design and construction, fit the instrument for use in four distinct fields of exploration:

(a) Determination of the amplitude or extent of a variation, such as of alternating current or voltage, of sound waves, or of vibration.

(b) Determination of the relations between two performance characteristics of the same circuit, or instrument, such as between current and voltage or between torsion and vibration.

(c) Determination of the wave form produced by plotting the variation of some quality against time, such as of alternating current, voltage, sound, speech, vibration, or nerve reaction.

(d) Determination of frequency by comparison with a frequency standard, and accurate measurement, by means of frequency match, of all factors capable of affecting frequency.

Further Information

For further information about the Western Electric Cathode Ray Oscillograph and associated equipment, you are invited to address any Western Electric distributor whose name appears on the last page of this bulletin.

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