DU MONT

VOL. 7 NO. 1 JAN.-FEB. 1945

OSCILLOGRAPHER

Due to the great amount of development work carried on by the Du Mont Laboratories in connection with the war effort, printing of the Oscillographer was suspended for the year of 1944. Commencing with this issue, however, we are renewing our policy of keeping you regularly informed of the latest cathode-ray techniques.

MAGNIFICATION OF DETAILS IN A COMPLEX WAVE FORM

by

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In analyzing complex wave forms, it is frequently necessary to magnify small details which may be significant. It may be important, for example, to be able to examine in detail very high harmonics on power lines.

Two means of expanding the image on the screen of a cathode-ray tube are to increase the sweep amplitude or to increase the sweep frequency. The first method is limited by the point of overload of the amplifier, the second by the fact that increasing sweep frequency complicates the image and makes interpretation difficult, if not impossible. This phenomenon is illustrated in Figure 1, which describes the appearance of a sine wave (frequency F) when a sweep frequency of F (Figure 1A) or n x F (Figure 1B) is used. When the sweep frequency is n x F each one of the n pattern elements, which correspond to n equal time elements is spread out over the entire screen.

In order to construct the pattern shown in Figure 1B, the time base must be divided into n parts. Each point of division is then projected vertically so

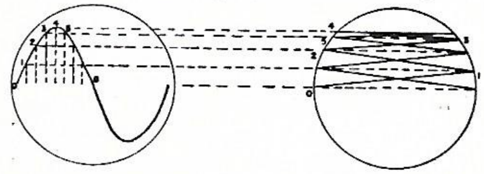

Fig. 1.

as to intersect the sine wave. These sine wave intersection points are then projected horizontally to alternate sides of the second screen. Diagonals are instructed connecting the points in numerical succession. The resultant pattern indicates how intricate the image becomes in the case of a simple sine wave. Complicated wave forms produce patterns which are unintelligible and therefore practically useless.

METHOD

The basic ideas of this method are the use of the high speed sweep for magnification and the elimination of confusion by singling out one time element and supressing the rest. This is accomplished by applying short positive pulses to the grid of the cathode-ray tube at a repetitive rate equal to the fundamental frequency of the signal under observation. The tube is biased to cut off and consequently is illuminated only during the "on" period of the pulses. Any part of the oscillogram can be made visible by merely shifting the positive grid pulses by means of a phase shifting device.

The oscillographic recordings in Figure 2 depict a practical example. Figure 2A is the recording of a 60 cycle wave containing a large number of high frequency harmonics (the voltage across a fluorescent lamp obtained by capacitive coupling). It is these harmonics which we wish to examine closely.

Positive pulses are applied to the grid of the cathode-ray tube and phased so that they cover the section of the oscillogram which we wish to observe.

Figure 2B shows the same picture after the tube has been biased to cut off. Only the section of the wave covered by the pulse remains visible.

In Figures 2C and 2D, the sweep frequency has been increased until the pulse is extended over the entire screen. To obtain the pattern shown in Figure 2D, the sweep frequency was increased to about 5000 cps. This corresponds to a magnification of 83.

The last illustration, Figure 2E, shows the pattern obtained using a sweep frequency of 5000 cps without any grid pulse, and with the cathode-ray tube at zero bias. It is evident that the resultant pattern is of no use so far as interpretation of the impressed signal is concerned.

EQUIPMENT

Standard Du Mont equipment may be used for this procedure. Any oscillograph containing a X-axis amplifier will be satisfactory. (Types 175-A, 224-A, 241, 247 or 248) Positive grid

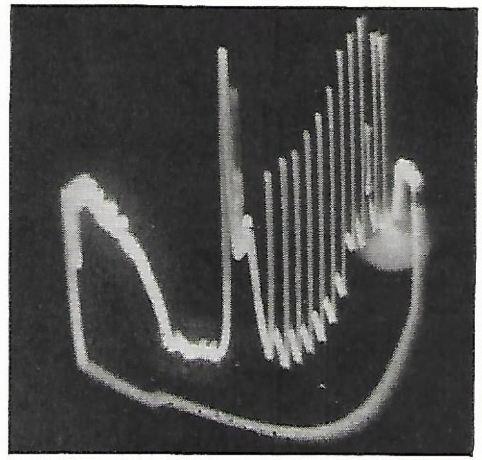

Fig. 2-A

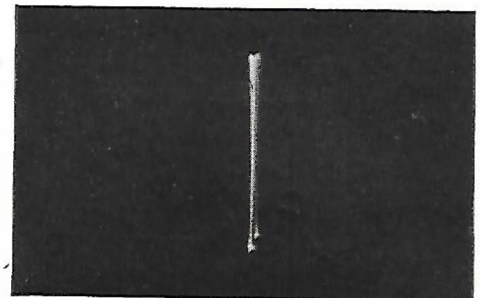

Fig. 2-B

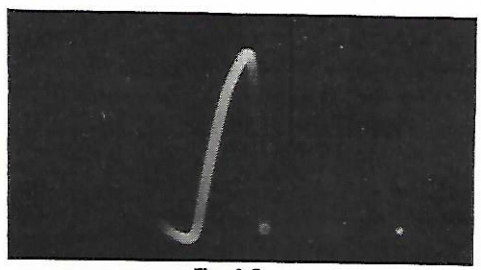

Fig. 2-C

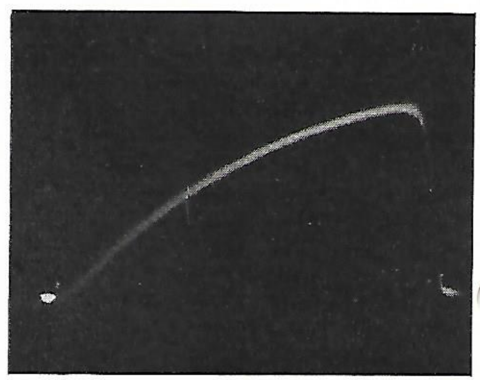

Fig. 2-D

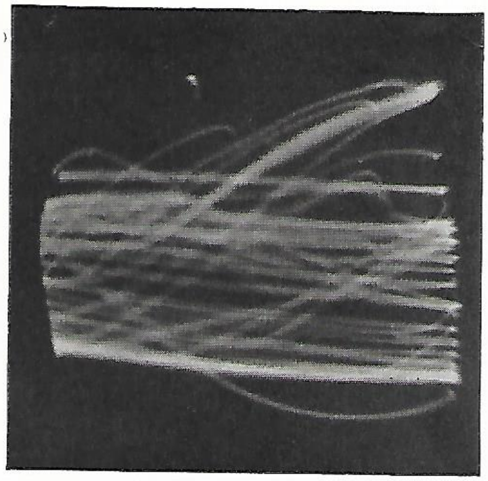

Fig. 2-E

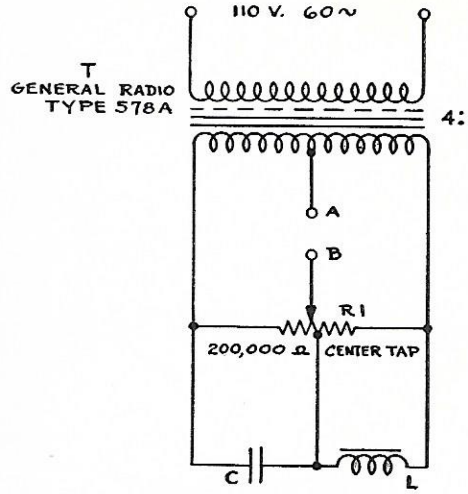

Fig. 3

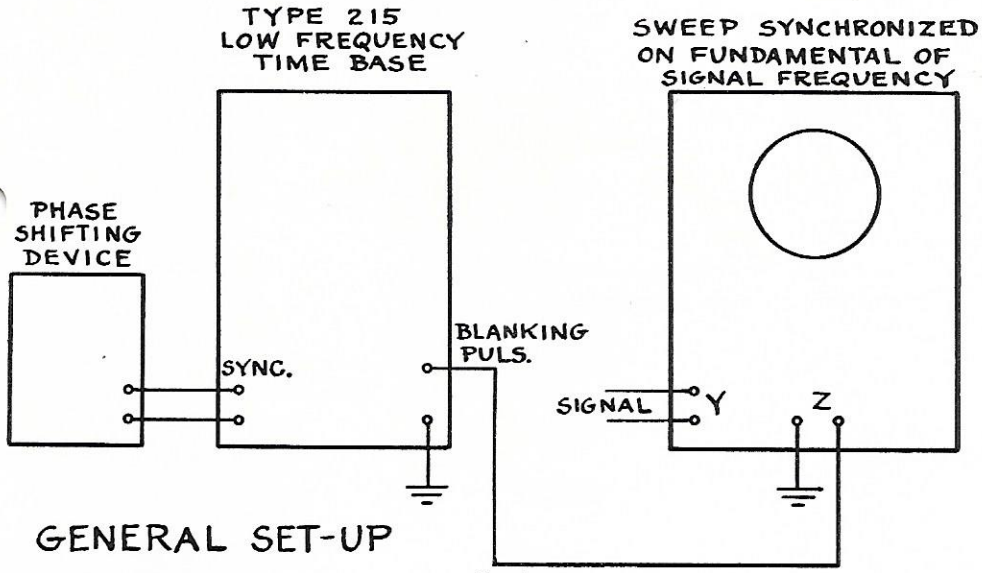

Fig. 4

pulses can be obtained from a Type 215 low frequency time base. The time base must be synchronized at the fundamental frequency of the phenomenon under observation. A limited amount of phase control can be secured from the synchronization and frequency controls of the Type 215 time base. A 360° phase shifting device, however, is desirable. The simple circuit of Figure 3 was employed in obtaining the pattern shown in Figure 2. The capacitance C and the inductance L are selected to resonate at the fundamental frequency. Transformer T is a General Radio Type 578-A which is provided with electrostatic shielding between the two windings. R1 is a 200,000 ohm centertap potentiometer. By means of R1, the phase of point B can be shifted from +90° to —90° with respect to A. (A being grounded). If the connections to A & B are reversed, an additional phase shift of 180° can be obtained. Figure 4 shows the circuit in block diagram form.

ANNOUNCEMENT OF NEW SCREEN DESIGNATIONS

A change has been made in the designation of the Du Mont blue sulphide screen, as a result of standardization within the industry. Formerly known as the P5, this screen will henceforth be designated as the P11. No change has been made in the screen material.

The P5 designation will hereafter be applied to a blue calcium tungstate screen.

Bulletins giving complete information on the P5 and P11 screens are available upon request.