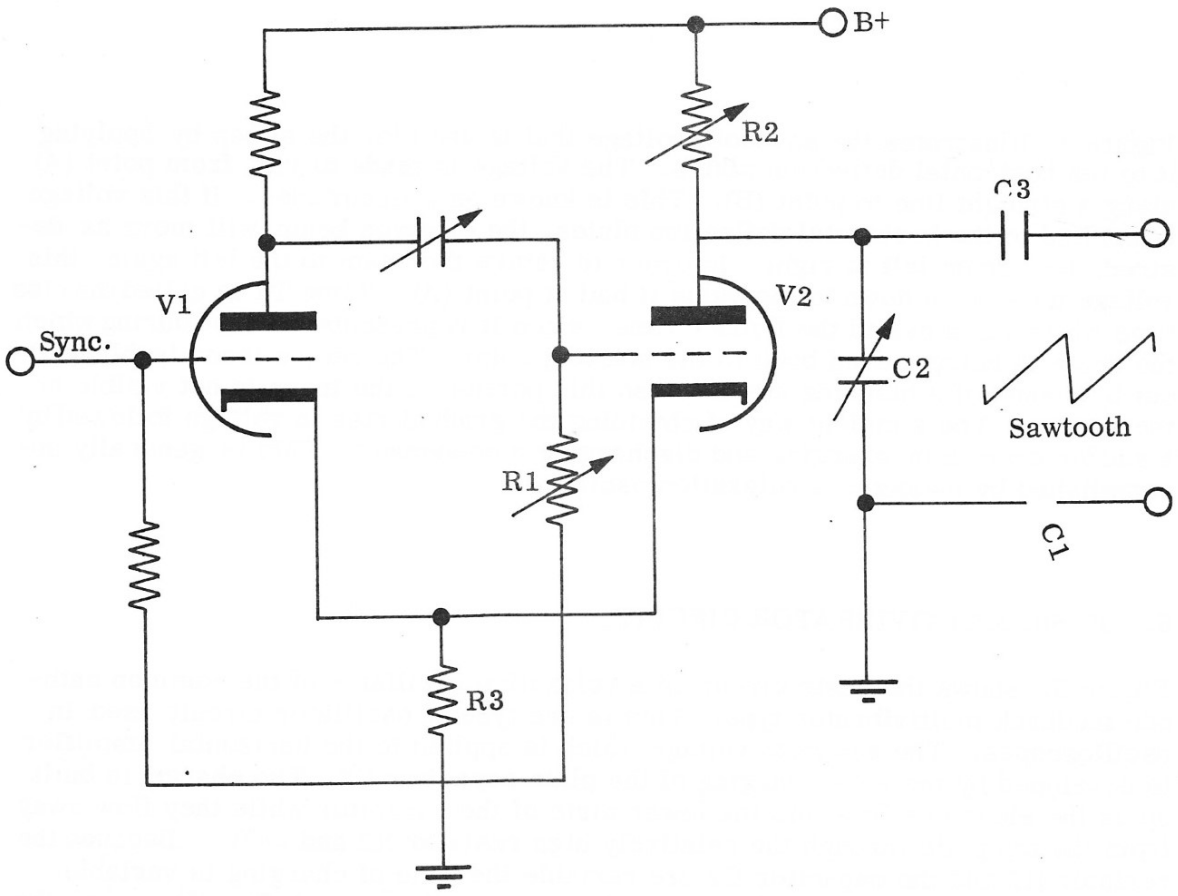

Figure 5. BASIC MULTIVIBRATOR CIRCUIT

In order to obtain a stationary pattern on the oscilloscope screen, the period of sweep must be exactly equal to the period of waveform, or some whole multiple thereof. If the length of the two periods are almost the same, the pattern will drift across the face of the screen. The speed at which the movement takes place depends upon the difference in frequency between the signal and the sweep.

It is necessary to synchronize the sweep generator with the waveform being observed in order to obtain a stationary pattern. This is accomplished by synchronizing the signal applied to the sweep generator in such a manner as to trigger the oscillator at exactly the correct interval of time, as was shown in block diagram Figure 3. Synchronization may also be obtained from other sources, such as the 60 cycle line voltage, or any other external voltage that may be desired. The switch on the front of the panel marked SYNC., controls the selection of internal or external sync. When the switch is at EXT., the synchronizing voltage must be connected to the EXT. SYNC. binding post.

6. POSITIONING CONTROLS:

In almost every application of the cathode ray oscilloscope, it is necessary to be able to move the whole trace to the most desirable part of the screen. Positioning is accomplished by the application of a D.C. voltage to the deflection plates. To move the trace on the screen in any direction, a D.C. voltage is applied to the vertical and horizontal plates by the controls marked VERT. POS. and HOR. POS. on the OSK-4 front panel.

7. POWER SUPPLY:

In order to supply the voltages required by the various circuits of the cathode ray oscilloscope, the power supply consists of three separate voltages.

1) High voltage negative supply

2) Low voltage supply (positive and negative)

3) Heater supply

The high voltage negative supply provides the cathode ray tube accelerating anode potential as well as operating potentials for proper intensity and focusing of the cathode ray tube beam.

The low voltage supply provides the necessary D.C. potential for operation of the horizontal and vertical amplifiers, and the synchronizing and sweep circuits. The heater supply supplies A.C. voltage to the filaments of the tubes, and the operating voltage for the phasing control.

SECTION III - OPERATION

This section will serve to explain the function of the controls and terminals on the front panel of the Model OSK-4 oscilloscope.

1. INTENSITY:

This is a dual function power switch and intensity control. Rotating the intensity control from the OFF position will turn the unit on, as indicated by the pilot light. The control is further rotated until the trace is visible with sufficient brightness. The trace should be kept just sufficiently bright for easy viewing.

2. FOCUS:

Controls the size of the electron beam on the cathode ray tube. The focus control should be adjusted to give a trace that is sharp and clear. Re-focusing is generally necessary when re-adjustment of the intensity control is made.

NOTE: A sharply focused line or spot of high intensity, having short length or small area, should not be permitted to remain stationary on the screen for any considerable length of time. Under such conditions, the entire energy of the beam is concentrated over a small area, thus subjecting the screen material to burning and discolouration.

3. VERT. POS.:

Adjusts the position of the beam either up or down.

4. HOR. POS.:

Adjusts the position of the beam either to the left or right.

5. VERT. GAIN:

Controls the amplitude of the vertical deflection.

6. HOR. GAIN:

Controls the amplitude of the horizontal deflection.

7. VERT. ATTEN.:

Provides for input signal attenuations of 1, 10, 100 and 1000, also provides setting for calibration voltage of 200 mv, p-p semi-rectangular square wave.

8. SWEEP SELECT:

Selects horizontal sweep frequency in four steps as follows: 10 to 100 cps,
100 to 1000 cps,
1 to 10 kc,
10 to 100 kc.

On position V, the sweep frequency may be preset for any frequency between 10 and 100 cps. by means of the potentiometer R56. This potentiometer may be adjusted through the hole on the right side of the cabinet near the front. The upper potentiometer is for setting the V frequency, usually set at 30 cps. and the lower potentiometer is for setting the H frequency. This frequency may be set anywhere between 1k and 10 kc and is normally preset for 7875 cps.

On the EXT. CAP position, external capacitors may be added to the cathode of the horizontal oscillator via the binding post on the front panel marked EXT. CAP and thereby reduce the oscillator sweep rate to as low as 1 cps.

On LINE FREQ. position, the horizontal sweep frequency is the same as the power line frequency.

When it is desired to use an external signal for the horizontal deflection, the switch is rotated to the EXT. INPUT position.

9. VERNIER:

A variable control of the frequency of the sawtooth sweep oscillator within the range covered by any one of the four positions of the SWEEP SELECT switch and the EXT. CAP position.

10. PHASING:

Effective only when the SWEEP SELECT switch is in the LINE FREQ. position and is used to superimpose the forward and return trace when the oscilloscope is used for visual alignment.

11. SYNC. AMP.:

A variable control permitting adjustment of the amount of locking voltage used to synchronize the sweep circuit oscillator.

12. SYNC. SELECT:

Selects the type of synchronization desired, either positive or negative internal synchronization, or positive or negative external synchronization. When external synchronization is desired, the synchronizing signal is connected to the EXT. SYNC. terminal. When switched to the LINE position, the sweep may be synchronized to the LINE frequency.

13. VERT. INPUT:

There are two binding posts for the connection of external signals to be applied to the vertical amplifier. The post marked A.C. is for A.C. signals and will block any D.C. component of the signal. The post marked D.C. is for D.C. signals and bypasses the input condenser on the A.C. terminal post.

14. HOR. INPUT:

A binding post connection for external signals to be applied to the horizontal amplifier. When this mode of operation is desired, the SWEEP SELECT switch must be in the EXT. INPUT position.

15. EXT. SYNC:

External voltages may be applied to the terminal for locking the sweep oscillator. The SYNC. SEL. switch must be in the EXT. position for this mode of operation.

16. LINE:

A terminal supplying a voltage of 3.15 volts RMS at the line frequency.

17. D.C. BAL.

A control to eliminate the Vertical shift in positioning when the vertical gain control is adjusted. This is a screw-driver adjustement located directly above the Sync. Amp. control on the front panel. Before adjusting, allow approximately a 20 minute warm-up time for the voltages to become stabilized. Set the Vert. Atten. control to the X1 position. While rotating the Vert. Gain Control between 0 and 100, adjust the D.C. Bal. control so that there is minimum shifting of the trace on the oscilloscope screen.

In addition to the above controls and terminals, there is a spot shape control, Z axis input terminal and a Direct to Horizontal plate input terminal located at the rear of the chassis and accessible without removing the cabinet.

The spot shape control is used in conjunction with the focus control to initially adjust the trace for best focus.

The Z axis input terminal is the red terminal adjacent to the fuseholder. This terminal provides for the connection of external signals to intensity modulate the trace.

The Direct to Horizontal plate input terminal is the black terminal adjacent to the Z axis input terminal. This terminal is connected to the Cathode Ray Tube Horizontal Plate D1 through a .1 ufd 600 volt capacitor and is used when it is desired to connect a signal directly to the horizontal plate without passing through the horizontal amplifier section.

18. SEQUENCE OF OPERATION:

a) Plug in line cord.
b) Turn on ON-OFF switch (Intensity Control).
c) SYNC. SEL. switch to +INT.
d) Set SWEEP SELECT switch to desired frequency.
e) Set Horizontal and Vertical positioning controls to center of rotation.
f) Increase intensity control until brilliance of trace is at the desired brightness.
g) Adjust focus for sharpest trace.
h) Advance Horizontal and Vertical gain controls for desired deflection.
i) Further setting of the controls will depend upon the application made.

19. CAUTIONS:

a) Never exceed the input peak voltages to the input terminals. Refer to technical data sheet for maximum input allowable.
b) The life of the cathode ray tube will depend on the brilliancy used.
c) To prevent horizontal distortion, use as little synchronizing voltage as possible which will cause the trace to remain stationary.

20. VERTICAL AND HORIZONTAL PLATES, DIRECT CONNECTION:

Connections directly to the cathode ray tube deflection plates are accessible after removing the covering plate on the right side rear of the cabinet.

WARNING:

The voltages that appear at the terminals of the direct connection terminal board are by necessity high and dangerous to human life. Before making any changes or connections to the terminal board, the oscilloscope must be disconnected from the power source.

For normal operation, the horizontal and vertical amplifier terminals are connected to the cathode ray tube deflection plates by means of the jumper wire as shown in Figure 6.

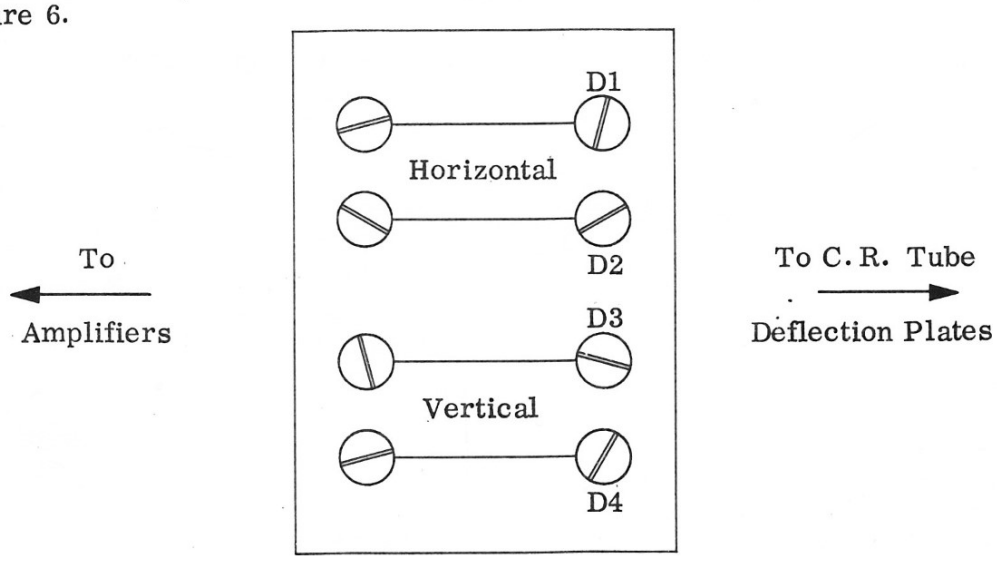

Figure 6. DEFLECTION PLATE DIRECT CONNECTION

To connect directly to the vertical deflection plates of the cathode ray tube, remove the jumper wires connecting the vertical amplifier terminals to the direct terminals D3 and D4.

For balanced inputs, connect the signal to terminals D3 and D4 through a .1 mfd. 400 volt isolating capacitor. Join the oscilloscope and the signal source by means of a common ground.

For unbalanced inputs, connect terminal D4 to ground through a .1 mfd, 400 volt capacitor. Connect the signal source directly to ground and through a .1 mfd, 400 volt capacitor to terminal D3.

To connect directly to the horizontal deflection plates, follow the procedure as outlined for the direct vertical connection, but making connections to horizontal terminals D1 and D2.

SECTION IV - CALIBRATION

The Model OSK-4 oscilloscope is fully calibrated at the factory and should require no further calibration.

In the event that the vertical attenuator requires re-calibration, the vertical attenuator must be frequency compensated in the X10, X100 and X1000 positions by means of trimmer capacitors C2A, C2B and C2C respectively.

Compensation is adjusted by applying a 10 kc square wave to the VERTICAL INPUT terminals and adjusting the appropriate trimmer to pass the square wave with minimum of distortion. In Figure 7., "A" represents proper adjustment, while "B" and "C" represent conditions of over-compensation and under-compensation respectively.

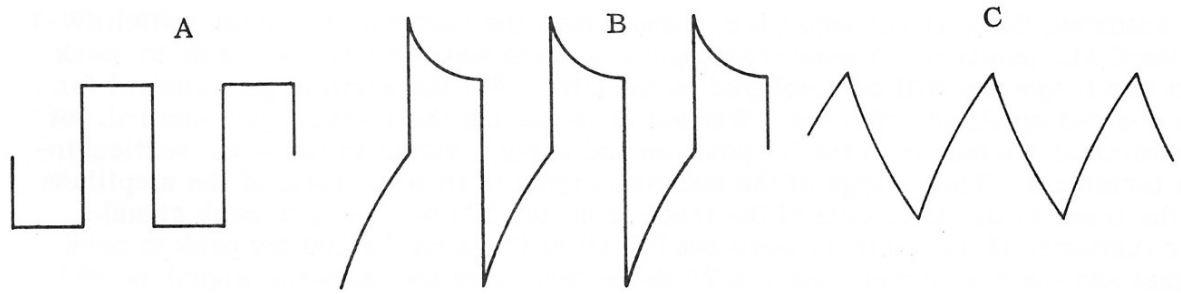

Figure 7. SQUARE WAVE ADJUSTMENT

Set the controls as follows:

a) Intensity and focus controls for proper brightness and clearness of trace.
b) Horizontal and vertical positioning controls for centering trace location on screen.
c) Vertical and horizontal gain controls for desired amplitude of trace.
d) Sweep selector switch to 10 kc.
e) Sync. amplifier and vernier controls set to lock a steady pattern.
f) Sync. selector to + INT. position.

With the vertical attenuator set at the X10 position, apply the 10 kc square wave to the vertical input binding posts and adjust the output of the generator and vertical gain control for approximately a two inch deflection. Using a non-metallic screwdriver adjust the bottom trimmer at the side of the chassis near the vertical gain control until the square wave shows minimum distortion.

Switch to the X100 position, adjust the output of the square wave generator for appropriate deflection and adjust the center trimmer until the square wave shows minimum distortion.

Switch to the X1000 position. Adjust the output of the square wave generator for appropriate deflection and adjust the top trimmer until the square wave shows minimum distortion.

SECTION V - TYPICAL APPLICATIONS

1. VOLTMETER:

The advantages of the oscilloscope as a voltmeter are its very high input impedance, its ability to measure equally well voltages of a very wide frequency range, and its ability to indicate magnitude regardless of waveform. The oscilloscope will indicate peak to peak values of voltage.

In order for the oscilloscope to be used as a measuring device, it must first be calibrated. By calibration, it is meant to note the deflection in inches of the vertical trace when a known voltage is applied to the vertical input terminals.

To calibrate the vertical amplifier, simply turn the vertical attenuator switch SW-1 to the CAL. position. A semi-rectangular square wave of 200 mv. peak to peak and line frequency will be displayed on the CRT. Set the vertical gain control for the desired amplitude of trace. Without re-adjusting the vertical gain control, set the vertical attenuator to the X1 position and apply a signal to the A.C. vertical input terminals. The voltage of the unknown signal is then the ratio of the amplitude of the trace to the amplitude of the trace from the 200 mv. peak to peak signal. For instance, if the controls were set for 1" of trace on the 200 mv peak to peak signal and the new signal caused a 2" deflection, then the unknown signal is 400 mv. peak to peak.

For the measurement of D.C. signals, apply the unknown signal to the D.C. terminals. The voltage of the unknown signal is then the ratio of the deflection of the trace to the amplitude of the trace from the 200 mv. peak to peak signal. Note that the signal is not attenuated at all but is fed directly to the vertical amplifier on the X1 position of the vertical attenuator.

On the X10 position, the signal is attenuated by a factor of 10, in other words, the trace will have one-tenth it had on the X1 position.

On the X100 position, the signal is attenuated by a factor of 100 and on the X1000 position, the signal is attenuated by a factor of 1000.

2. AMMETER:

It is possible to use an oscilloscope as a sensitive device to indicate current values. The method is indirect, but nevertheless accurate. It is based on Ohms law, that is, the voltage drop across a resistor is proportional to the current passed through it, providing the resistance is kept constant. An example of this would be: If we had an unknown current to be measured, we would first calibrate the scope as explained in V 1. We would then pass the unknown current through a resistor of known value and connect leads from the vertical terminals of the oscilloscope to either side of the resistor. In this way, we are measuring the voltage drop across the resistor and can interpret this value by noting the deflection of the electron beam.