

nal is applied to the input, and second, when a 1000-cycle signal of the same voltage as the 400-cycle signal is applied to the input. The correct value of capacitance is the one which gives equal output voltages for the two signal inputs. In practice, this value is usually found to be in the order of 0.05 microfarad.

### Volume Expanders

A volume expander can be used in a phonograph amplifier to make more natural the reproduction of music which has a very large volume range. For instance, in the music of a symphony orchestra, the sound intensity of the loud passages is very much higher than that of the soft passages. When this music is recorded, it may not be feasible to make the ratio of maximum amplitude to minimum amplitude as large on the record as it is in the original music. The recording process may therefore be monitored so that the volume range of the original is compressed on the record. To compensate for this compression, a volume-expander amplifier has a variable gain which is greater for a high-amplitude signal than for a low-amplitude signal. The volume expander, therefore, amplifies loud passages more than soft passages.

A volume expander circuit is shown in Fig. 33. In this circuit, the gain of the 6L7 as an audio amplifier can be varied

grid of the 6J5, is amplified by the 6J5, and is rectified by the 6H6. The rectified voltage developed across  $R_8$ , the load resistor of the 6H6, is applied as a positive bias voltage to grid No. 3 of the 6L7. Then, when the amplitude of the signal input increases, the voltage across  $R_8$  increases, and the bias on grid No. 3 of the 6L7 is made less negative. Because this reduction in bias increases the gain of the 6L7, the gain of the amplifier increases with increase in signal amplitude and thus produces volume expansion of the signal. The voltage gain of the expander varies from 5 to 20.

Grid No. 1 of the 6L7 is a variable-mu grid and, therefore, will produce distortion if the input signal voltage is too large. For that reason, the signal input to the 6L7 should not exceed a peak value of 1 volt. The no-signal bias voltage on grid No. 3 is controlled by adjustment of contact P. This contact should be adjusted initially to give a no-signal plate current of 0.15 milliamperes in the 6L7. No further adjustment of contact P is required if the same 6L7 is always used. If it is desired to delay volume expansion until the signal input reaches a certain amplitude, the delay voltage can be inserted as a negative bias on the 6H6 plates at the point marked X in the diagram. All terminal points on the power-supply voltage divider should be adequately bypassed.

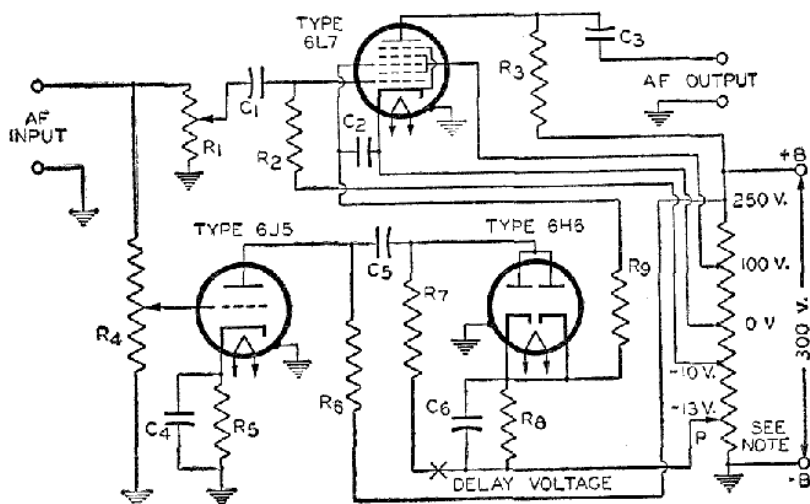


Fig. 33

- $C_1, C_3, C_5 = 0.1 \mu\text{f}$
- $C_2, C_4, C_6 = 0.5 \mu\text{f}$
- $R_1 = 1\text{-Megohm Potentiometer (Volume Control)}$
- $R_2 = 1 \text{ Megohm}$
- $R_3, R_6 = 100,000 \text{ ohms, } 1 \text{ watt}$
- $R_4 = 1\text{-Megohm Potentiometer (Expansion Control)}$
- $R_5 = 10,000 \text{ ohms, } 0.1 \text{ watt}$
- $R_7 = 100,000 \text{ ohms, } 0.1 \text{ watt}$
- $R_8 = 250,000 \text{ ohms, } 0.1 \text{ watt}$
- $R_9 = 500,000 \text{ ohms, } 0.1 \text{ watt}$

by changing the bias on grid No. 3. When the bias on grid No. 3 is made less negative, the gain of the 6L7 increases. The signal to be amplified is applied to grid No. 1 of the 6L7 and is amplified by the 6L7. The signal is also applied to the

### Phase Inverters

A phase inverter is a circuit used to provide resistance coupling between the output of a single-tube stage and the input of a push-pull stage. The necessity for a phase inverter arises because the