Variable band-pass filter

Sometimes it is required to have a high-Q, bandpass filter which is adjustable over a wide frequency range without an appreciable change in Q, or more particularly, without the loop-gain becoming greater than unity which causes oscillation. With this circuit the centre frequency can be adjusted over a 100:1 range whilst maintaining Q>100, and over smaller frequency ranges, a Q of up to 10^4. In addition, a two-phase output is also available.

Two cascaded all-pass networks, B and C, each have a 0° to 180° phase variation, and unity gain at all frequencies. This cascade is driven from a third operational amplifier whose feedback signal is the sum of the input and output of the all-pass network. The sum becomes zero when there is exactly 180° phase shift over the cascade, and thus the overall gain approaches half the open-loop gain of amplifier A. At other frequencies the gain tends towards unity.

Because the frequency determining components only affect the overall phase-shift and not the gain, there is a no danger of having a loop-gain greater than unity. If the two-phase output or large frequency range is not required one R can be fixed. The Q is adjusted by R_2, and with the values shown gives the circuit a 20Hz to 2kHz range.

J. M. Worley,
Colchester,
Essex.