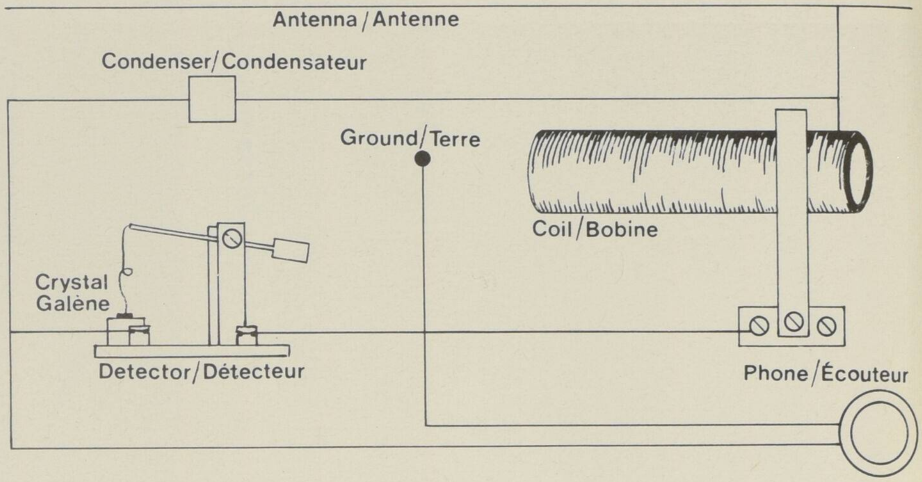
Surface accoustic waves —

Electronics on the tip of your finger

Electronic signals can be converted into sound waves confined to the surface of a small crystal. In this way, precision filters are custom designed for communications equipment.



Crystal set / Poste à galène

From a schoolboy's crystal set to a sophisticated radar installation, an electronic filter lies at the heart of all communications circuits. In the crystal set, the filter takes its crudest form — a hand-wound coil and a simple capacitor. Simply put, this combination selects, from the jumble of electromagnetic signals picked up in an antenna, the frequency of a desired radio program.

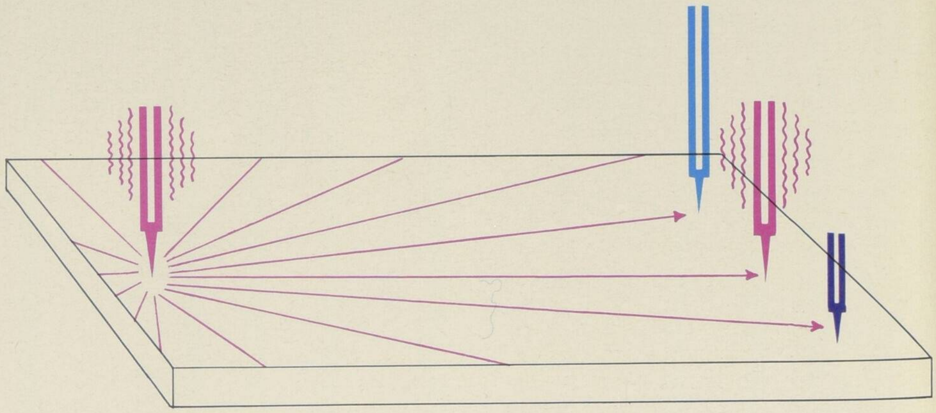
Filters are placed in a circuit to allow a particular band of frequencies to pass on to a further stage of electronic processing (to be amplified, for example) and are designed to "filter out" all other frequencies. One circuit may demand that an extremely narrow band of frequencies be allowed to pass, while another may require the passage of signals at many different frequencies.

For certain requirements, the conventional electronic filter has reached its developmental limit — it is simply not sufficiently sensitive or versatile in its operation. In addition, no matter how carefully the components are assembled, the filter usually requires some additional "tweaking" or manual adjustment when it is installed in a circuit.

Dr. D. P. Akitt of the Division of Electrical Engineering is turning to a radically different principle in the design of filters — Surface Acoustic Waves (SAW). The operation of a SAW filter can be explained through the following analogy.

Suppose an orchestral tuning fork, which sounds concert A, is mounted in the centre of a table. If a second concert A fork is struck and brought up to the edge of the table then the first fork will begin to vibrate in sympathy. What happens is that vibrations from the second fork — at a frequency corresponding to concert A — travel through the table and excite the fork mounted in its centre. However, if some other fork, tuned to a different frequency, is brought up to the table, nothing will happen. Although vibrations pass through the table our first tuning fork is not excited — it responds only to vibrations at its own frequency.

In a sense, the two forks and the table have acted as an acoustic filter, permitting sound to pass from one fork to the other, provided that both forks are in tune — all other frequencies are "filtered out".



John Brittain

Concert tuning forks rest passively on a table as a vibrating concert fork is lowered towards the surface. Sound vibrations pass along the surface of the table and excite the tuning fork.

Si l'on approche un diapason excité de la surface d'une table où se trouvent des diapasons au repos, les vibrations sonores se propagent à la surface de la table et excitent le diapason de fréquence identique.

The SAW filter acts by converting electrical signals into high frequency vibrations which are confined to the surface of a tiny crystal. The vibrations travel between a transmitter and receiver mounted on the surface of the crystal. The transmitter and receiver are simply geometrical patterns of metal which are "tuned" to a particular frequency. As with the example of the tuning forks, the SAW filter permits only the passage of those signals for which it is tuned. Since the tuning — or frequency response — of a SAW filter is related to the geometrical pattern of the metal strips mounted on its surface, the device has considerable advantages over its electronic cousin. Simply by altering the pattern of strips which are deposited on its surface, the characteristics of the device can be modified. The end result is a filter, operating in the 10-100 Megahertz (Mhz) range, of much higher selectivity, reliability and versatility than the conventional electronic alternative.

Dr. Akitt sees many applications for SAW devices in modern communications. Already they have been used as coded signal generators for long-range navigational radar and security transmission equipment.

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