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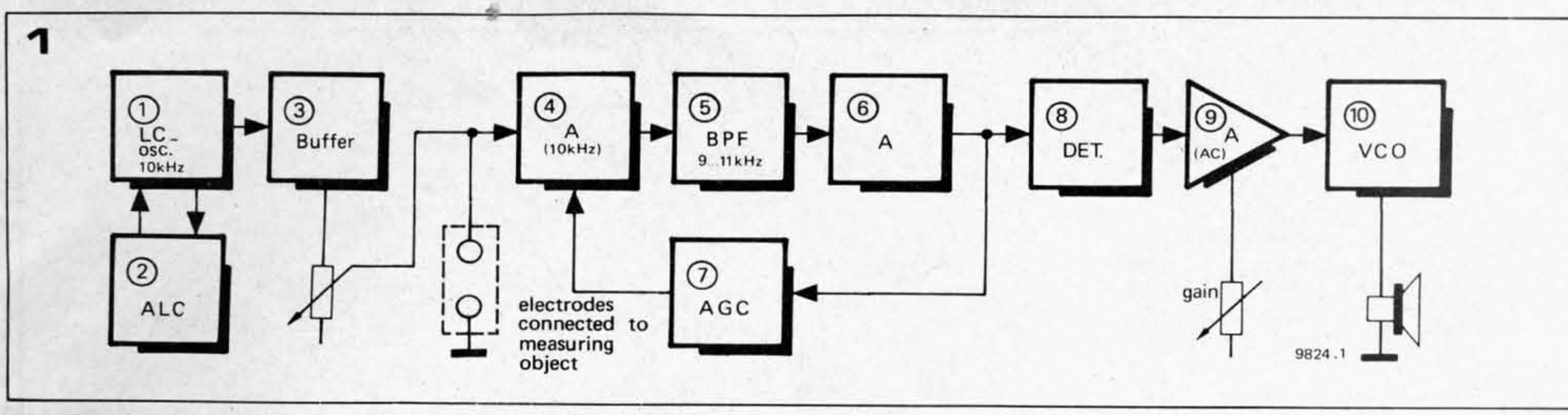

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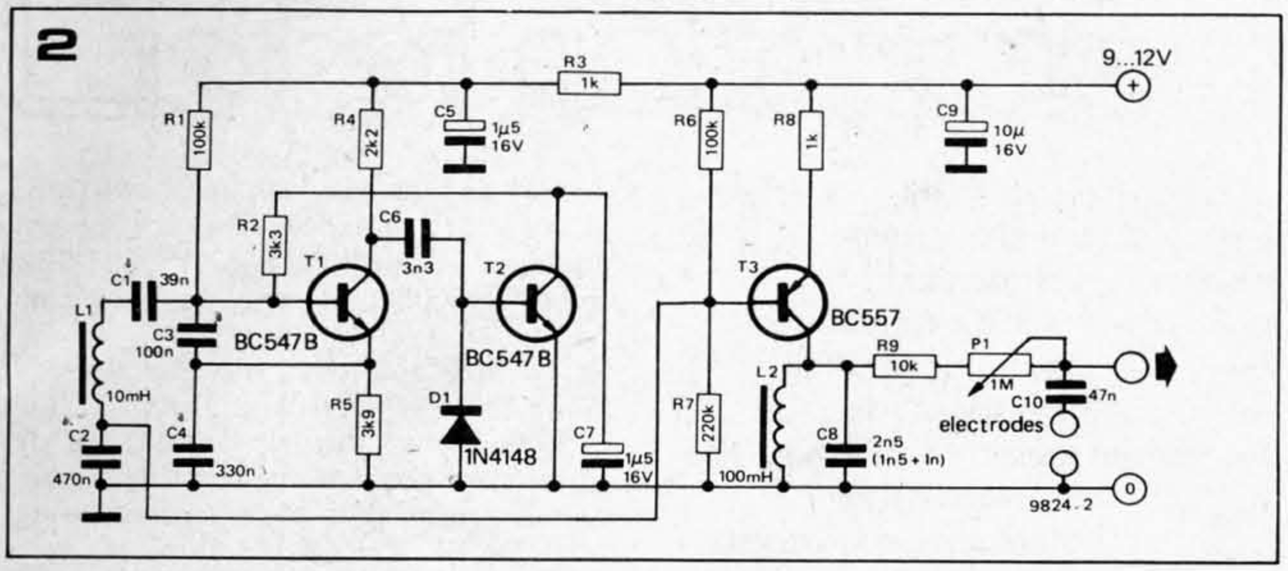

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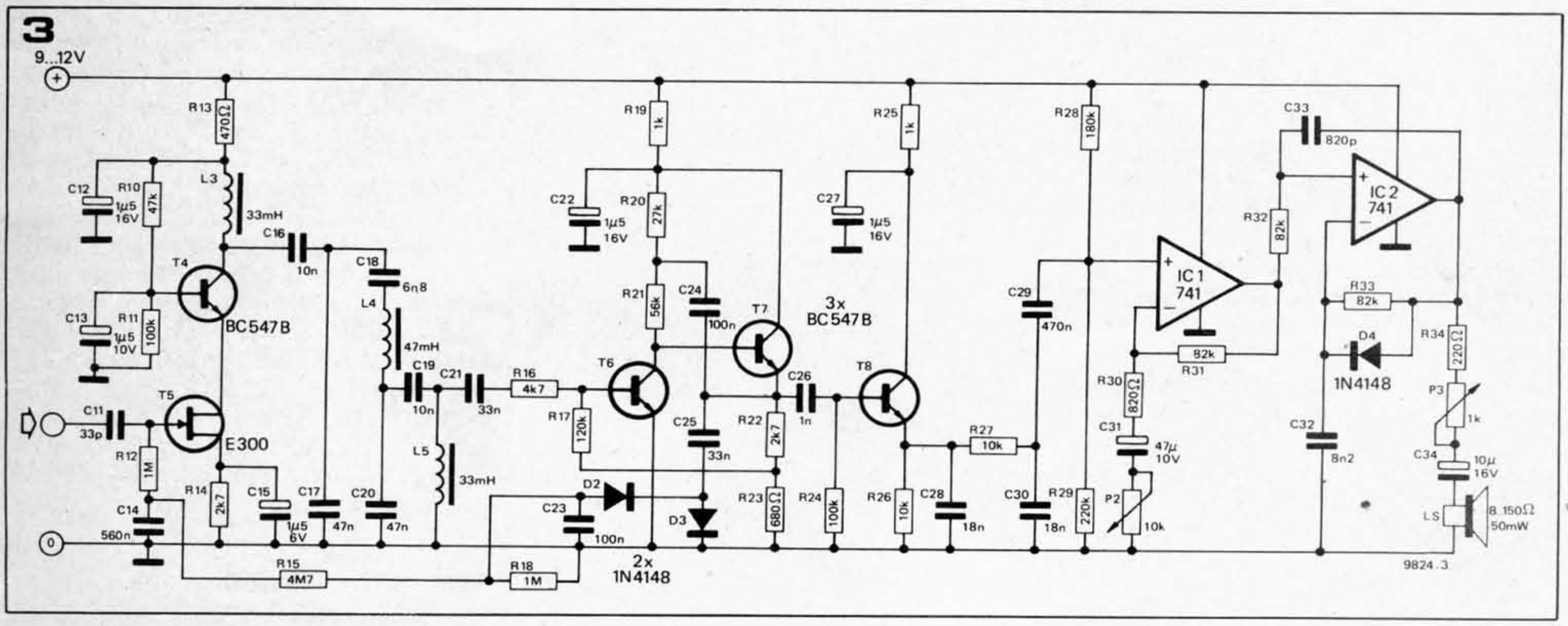

Figure 1. Block diagram of the impedance variation detector.

Figure 2. Circuit diagram of the 'transmitter'; it produces an amplitude- and frequency constant 10 kHz signal.

Figure 3. In the 'receiver' the 10 kHz signal is amplified and cleaned of transients. A delayed response automatic gain control ensures that only *changes* in impedance are registered as fluctuations in the pitch of an audible reference signal.

the object being measured, which together with the output impedance of the buffer stage constitutes a voltage divider. The division factor is variable by means of potentiometer P1.

The collector circuit of T3 contains an LC-parallel-resonant circuit (L2/C8) with a resonant frequency of 10 kHz. At this frequency the circuit has an extremely high, purely resistive impedance, so that the voltage gain is at a maximum at 10 kHz.

Figure 3 shows the circuit diagram of the 'receiver'. The input stage has a high impedance so as not to overload the voltage divider of the transmitter. The 10 kHz signal from the voltage divider is first amplified then fed to the selective LC-filter (C16 . . . C21/L3 . . . L5). Since the bandpass filter must be terminated in a specific impedance, it is succeeded by a virtual-earth amplifier (T6/T7). The characteristic impedance is determined by R16. Between this amplifier stage and the input stage is the control loop of the automatic gain control, consisting of R12, R15, R18, C14, C23, D2 and D3. If the amplitude of the input signal increases, then the output signal at the emitter of T7 will follow course. Diodes D2 and D3 produce a negative rectified voltage, and this is fed via the RC-network R15/C14 to the gate of transistor T5, so that the gain of the input stage (T4/T5) falls. Since the RC-network has a long time constant, this means that quite gradual changes in impedance will be detected.

The 10 kHz signal is next fed to the detector circuit round T8, whose output is AC-coupled to the voltage amplifier IC1. The AC-coupling means that the amplifier reacts only to *changes* in the DC-voltage produced by the detector and hence only to changes in the impedance of the object being measured. The amplifed voltage differences are used to control a VCO (IC2), which converts the changes in impedance into changes in the pitch of an audible signal. The sensitivity of the VCO can be varied be means of P2, and the volume of the loudspeaker signal by P3.

In conclusion

It will be apparent from the foregoing that impedance and resistance are two related, but by no means identical, quantities. The title 'impedance variation detector' was chosen since it is impossible to determine whether the potentially present inductance or capacitance of the object being measured remains constant or not. If, however, the intention is to measure only changes in resistance, then the imaginary components (inductance, capacitance) of the impedance cannot be included in the measurement. These components can be determined by calculating the phase angle between the input and output voltages of the voltage divider. ■