Moving in the other direction on the symbolised diagram of Fig. 5.6b, dQ/dt is integrated by OA2 to obtain $+Q$. Inverting amplifier OA3 changes the sign of Q before passing it on for multiplication by $1/LC = 100{,}000$ (CP2 coefficient of 1). $-(1/LC)Q$ is then added, at OA1/Input 3, to

$$-\frac{R}{L}\frac{dQ}{dt}+\frac{f(t)}{L}$$

and the sum of all OA1 input voltages yields the required d^2Q/dt^2. Because there are two closed-loops in the computer set-up the equation will be self-enforcing.

Routine. Switch on UNIT "A" power supply and allow a warm-up time of at least 15 minutes. Ensure that the three operational amplifiers are disconnected from their summer networks, and have no feedback components. Apply 10V d.c. voltmeter leads to OA1/SK13 and an earth socket, and zero-set OA1 for an output voltage of less than ± 1V from the back of the UNIT "A" box, by means of VR1 (Fig. 3.7). Repeat for OA2 and OA3.

Set up the problem according to the patching circuit of Fig. 5.6b, but omit the feedback capacitors and the patching link between OA3/SK13 and CP2/SK1. Set CP1 dial to approximately "1". Connect the voltmeter to miniature socket OA1/SK6 (Fig. 2.9) and zero-set OA1 again, but this time using the front panel control VR15.

Next, zero-set OA2 using VR16, and OA3 using VR17. Insert 0·1μF computing capacitors into OA1/SK11 and SK12, and OA2/SK11 and SK12, and make good the link between OA3 output and CP2. Set CP2 for a dial reading of "10". Apply the voltmeter to OA2/SK7 and zero-set the complete assembly of amplifiers by adjustment of VR15(OA1) only.

The problem layout will now be ready for dynamic checks and should not need to be re-zeroed for several hours if UNIT "A" is being operated in stable ambient temperature conditions.

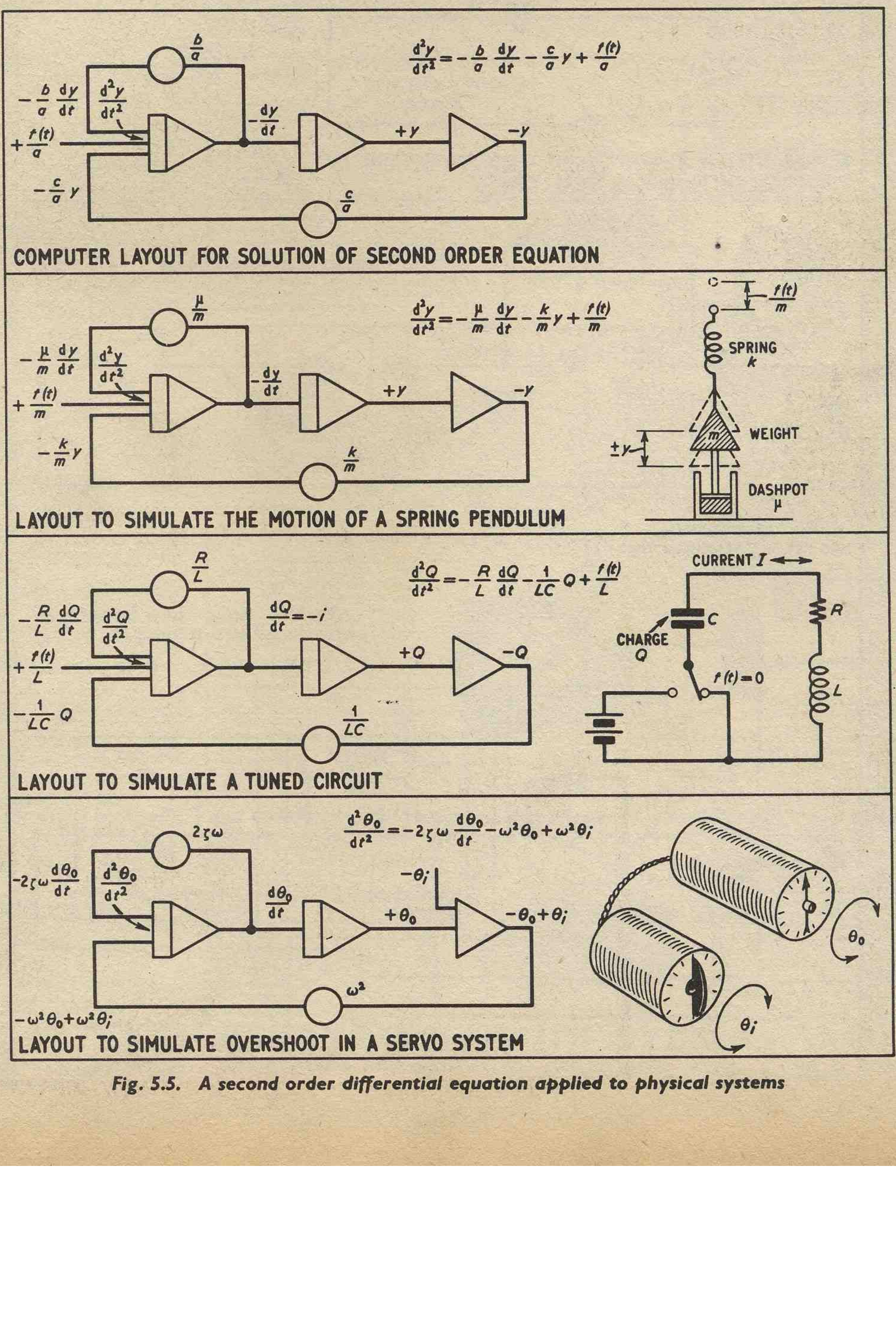

Fig. 5.5. A second order differential equation applied to physical systems