The determined value is subject to the following systematic error: the small ball is also attracted by the more distant second large ball, albeit with a much lower force (refer to Fig. 5).

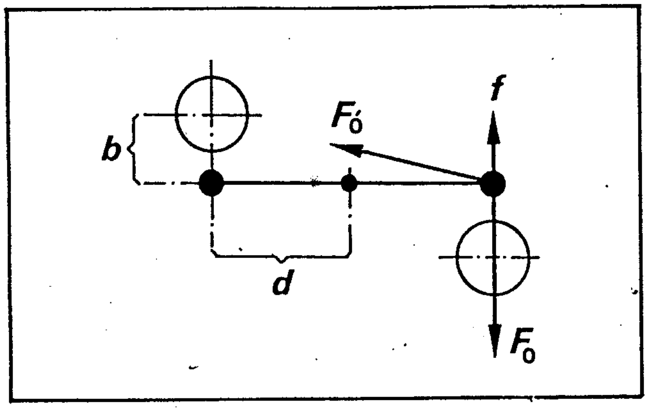

Fig. 5: Calculating the correction factor

In accordance with the gravitation law, this force is given by

$$F_0' = 2G \frac{m_1 m_2}{b^2 + 4d^2}$$

and has a component f opposed to the force F_0 to be measured

$$f = 2G \frac{m_1 m_2}{b^2 + 4d^2} \frac{b}{\sqrt{b^2 + 4d^2}} = \beta F_0,$$

if β is the fraction by which the observed force F_0 is reduced.

$$\beta = \frac{b^3}{(b^2 + 4d^2)\sqrt{b^2 + 4d^2}}.$$

β = 0.075 where d = 0.05 and b = 0.0465 m. The value for G obtained without this correction must therefore be increased by 7.5 %.

For our measurement example, we thus obtain

$G = 6{,}698 \cdot 10^{-11} m^3 kg^{-1} s^{-2}$

instead of the theoretical value

$G = 6{,}705 \cdot 10^{-11} m^3 kg^{-1} s^{-2}$.