One method of compacting powder materials consists in magnetic pulse pressing [1, 2]. In this method a conducting shell with powder inside it is compressed by pulse magnetic field forces and then removed from the resultant compact before sintering. In many cases the concluding shell-stripping operation may be performed using the forces of a pulse magnetic field generated by an inductor placed inside the compact (Fig. 1) [2]. In pressing by this method, which is characterized by high productivity, the shell can be reused many times, and the same apparatus is employed for pressing the powder and stripping the shell.

In order to be able to choose the key parameters of the inductor and apparatus, it is necessary to construct a theoretical model of the process of stripping the shell from the compact. We will make two assumptions.

1. The electromagnetic field of the inductor-compact-shell system is unidimensional (such an assumption is valid in the case of a system whose length is several times greater than its diameter).

2. Between the shell and the compact there are no adhesion forces due to interdiffusion of their materials. Such a phenomenon would be undesirable, and recourse may be had to special measures in order to prevent it (e.g., the inside surface of the shell may be coated with a layer of a low-melting-point material, such as paraffin wax or bitumen, or a powder dressing may be applied to it).

The electromagnetic field of the inductor-compact-shell system is described by the equations [3]

$$E(R_k, t)I_k + \mu_0S_k \frac{dH(R_k, t)}{dt} + \frac{1}{w} \int [i(t)] = 0; \quad (1)$$

$$E(R_4, t)I_4 + \mu_0S_4 \frac{dH(R_4, t)}{dt} - E(R_3, t)I_3 - E(R_1, t)I_1$$
$$- \mu_0S_h \frac{dH(R_5, t)}{dt} = 0; \quad (2)$$

$$E^{(2)}(R_3, t) - E^{(3)}(R_3, t) = 0, \quad (3)$$

where $E$ is the electric field strength; $\mu_0 = 2\pi\mu_0$ (k = 1, 3, 4); $\mu_0$, the magnetic constant; $S_k$ and $S_h$, the areas of the inductor opening and of the gap between the inductor and compact, respectively; $H$, the magnetic field strength; $w$, the number of inductor turns; and $t[i(t)] = r_c I + L_c (di/dt) + u_c$ (I is the current in the discharge inductor; $u_c$, the voltage drop across the reservoir capacitor; and $r_c$ and $L_c$, the natural parameters of the discharge circuit).

Equations (1) and (2) have been formulated, on the basis of the electromagnetic induction law and Kirchhoff's second law, for circuits bounding the inductor opening and the gap between the inductor and compact. Equation (3) expresses the continuity of the tangential component of the electric field strength on the compact/shell interface (the subscripts 2 and 3 refer to the compact and the shell, respectively).
The inductor current is related to the magnetic field strength by an expression obtained from the full-current law for the inductor,

\[ i = (b/w) [H(R_3, t) + H(R_4, t)], \]  

where \( b \) is the length of the inductor.

The initial conditions are

\[ H(r, 0) = 0, \quad i(0) = 0, \quad u_c(0) = -U_0, \]  

where \( U_0 \) is the initial reservoir capacitor voltage.

The problem expressed by Eqs. (1)-(5) was solved using recurrent formulas on a time grid [3], as a result of which expressions were obtained for the magnetic field strength in the inductor-compact-shell system as a function of time. The pressure on the shell was found with the familiar formula

\[ p = \frac{1}{2} \mu_0 H^2(R_3, t). \]  

In accordance with assumption 2, the shell can be removed from the compact when

\[ p > \sigma_s (d_s/R_2), \]