$$=\frac{1}{\bar{a}_1^2}\left[\frac{\partial p_1/\partial r}{\lambda-ikPe}\frac{\partial T_1}{\partial r}+p_1\left(\frac{m/r^2}{\omega-mPe}\frac{\partial T_1}{\partial\varphi}+\frac{k}{\omega-kPe}\frac{\partial T_1}{\partial x}\right)\right],$$

where $\delta_1^2=k^2-(\lambda+ikPe)/\bar{a}_1^2,\quad \delta_2^2=k^2-\lambda/\bar{a}_2^2$. Here $\bar{\kappa}_n=const$, therefore heat diffusivity coefficients $\bar{a}_i$ are constant too. For the amplitudes of velocity and pressure perturbations the same designations, as for the perturbations themselves, are kept.

As observed from (36), at high melt flow velocities $(Pe\gg1)$ when convective heat transfer prevails over molecular heat transfer, the amplitudes of the perturbed velocities are small, except the waves with $\omega=kPe$. In the latter case strong instability of system can take place. These waves at any Pe are resonant and lead to considerable fluctuations of melt temperature. Distribution of temperature in a solid phase doesn't depend on Pe but depends on k,m and frequency ω.

Boundary conditions for (37) with account (35):

$$r=0,\quad u_1=\theta_1=0; \qquad (38)$$

$$r=1,\quad u_1=(\rho_{21}-1)\lambda\zeta,\quad \theta_j=-\zeta\left(\partial T_j/\partial r\right)_{r=1},$$

$$\bar{\kappa}_2\frac{d\theta_2}{dr}-\frac{d\theta_1}{dr}=\zeta\frac{Pe}{\bar{a}_1^2}\left(\frac{\partial T_1}{\partial x}\right)_{r=1}-\lambda R_\lambda\zeta; \qquad (39)$$

$$r=s,\ d\theta_2/dr=-Bi_{k,m}\theta_2. \qquad (40)$$

Using (40) and accounting the correlation

$$\sin(\alpha_{2nk}s)=\frac{J_0(\alpha_{2nk})Y_0(\alpha_{2nk}s)-J_0(\alpha_{2nk}s)Y_0(\alpha_{2nk})}{J_1(\alpha_{2nk})Y_0(\alpha_{2nk})-J_0(\alpha_{2nk})Y_1(\alpha_{2nk})},$$

results in

$$\left(\partial T_1/\partial r\right)_{r=1}=\sum_{j=1}^{2}\sum_{n=1}^{4}\sum_{k=1}^{\infty}\alpha_{1k}J_1(\alpha_{1k})d_{jk}\exp\left(q_{3-j}\alpha_{2n}x\right), \qquad (41)$$

$$\left(\partial T_2/\partial r\right)_{r=1}=\sum_{j=1}^{2}\sum_{n=1}^{4}\sum_{k=1}^{\infty}\frac{\alpha_{2nk}b_{jnk}}{\sin(\alpha_{2nk}s)}\exp\left[(-1)^{j+1}\alpha_{jnk}x\right]\cdot$$

3.2.3 Calculation of the Eigen values for the task

Parameter R_λ as it was noted, for crystalline solids is big owing to what there is an opportunity to define Eigen values from the last boundary condition (39) solving (37)-(40), taking into account (41) by means of asymptotic decomposition of required functions in a series by λ. From (37), using $\theta_j=\theta_j^0+\lambda\theta_j^1+\lambda^2\theta_j^2+...,\ \vec{v}_j=\vec{v}_j^0+\lambda\vec{v}_j^1+\lambda^2\vec{v}_j^2+...,$ $p_1=p_1^0+\lambda p_1^1+\lambda^2p_1^2+...,$ yields

$$u_1^0=-\frac{i}{k}\frac{dw_1^0}{dr},\qquad \frac{d^2\theta_2^0}{dr^2}+\frac{1}{r}\frac{d\theta_2^0}{dr}-\left(k^2+\frac{m^2}{r^2}\right)\theta_2^0=0,$$

$$\frac{d^2w_1^0}{dr^2}+\frac{u_1}{r}\frac{dw_1^0}{dr}-\left[\frac{m^2(\omega-kPe)}{(\omega-mPe)r^2}+k^2\right]w_1^0=0, \qquad (42)$$

$$\frac{d^2\theta_1^0}{dr^2}+\frac{1}{r}\frac{d\theta_1^0}{dr}-\left(\delta_{10}^2+\frac{m^2}{r^2}\right)\theta_1^0=\frac{1}{\bar{a}_1^2}\left(u_1^0\frac{\partial T_1}{\partial r}+w_1^0\frac{\partial T_1}{\partial x}\right),$$

where $\delta_{10}^2=k^2-ikPe/\bar{a}_1^2$. Obviously even in zero approach the solutions exist only when the melt temperature gradients by r and x in equilibrium state are functions only of r. General solution of the differential equation array (DEA) (42):

$$u_1^0=-i\left[c_1I_q'(kr)+c_2K_q'(kr)\right],\ w_1^0=c_1I_q(kr)+c_2K_q(kr),$$

$$\theta_1^0=I_m(\delta_{10}r)\left[c_3-\int_0^r B_1^0(r)K_m(\delta_{10}r)dr\right]+ \qquad (43)$$

$$+K_m(\delta_{10}r)\left[c_4+\int_0^r B_1^0(r)I_m(\delta_{10}r)dr\right],\ \theta_2^0=c_5I_m(kr)+c_6K_m(kr),$$

where dash means derivative by independent variable in a brackets, c_j $(j=\overline{1,6})$- constants computed from boundary conditions. Here:

$$B_1^0=\frac{1}{\bar{a}_1^2\delta_{10}A_1^0}\sum_{j=1}^{2}\sum_{n=1}^{4}\sum_{k=1}^{\infty}\left\{\alpha_{2n}q_{3-j}J_0(\alpha_{1k}r)\left[c_1I_q(kr)+c_2K_q(kr)\right]+\right.$$

$$\left.-i\alpha_{1k}J_0'(\alpha_{1k}r)\left[c_1I_q'(kr)+c_2K_q'(kr)\right]\right\}d_{jk}\exp\left(q_{3-j}\alpha_{2n}x\right),$$

$$A_1^0=I_m(\delta_{10}r)K_m'(\delta_{10}r)-I_m'(\delta_{10}r)K_m(\delta_{10}r), \qquad (44)$$

$q=m\sqrt{\dfrac{\omega-kPe}{\omega-mPe}}$. From the equations obtained is seen that in a resonance $\omega=kPe$ is $q=0$, and by $k=m$ results $q=m$. By $\omega=mPe$ due to properties of I_q follows $w_1^0\approx0$ by all values kr, except $kr=\infty$.

$B_1^0(r)$ can be only slowly changing function x, then for example at $Pe\gg1$ it is necessary to keep in (44) only two values of α_2: $\alpha_2=\pm0,5\left(Pe-\sqrt{Pe^2+4\alpha_1^2}\right)$, having equated zero coefficients at two other values of α_2 ($T_{1x}^0=0$ in expression (41)).

Boundary conditions (38)-(40) in zero approach:

$$r=0,\quad u_1^0=\theta_1^0=0; \qquad (45)$$

$$r=1,\quad u_1^0=0, \qquad (46)$$

$$\theta_2^0=\chi_2^0\zeta=\zeta\sum_{j=1}^{2}\sum_{k=1}^{\infty}\sum_{n=1}^{4}\frac{\alpha_{2nk}b_{jnk}}{\sin(\alpha_{2nk}s)}\exp\left[(-1)^{j+1}\alpha_{2nk}x\right],$$

$$\theta_1^0=\chi_1^0\zeta=-\zeta\sum_{j=1}^{2}\sum_{k=1}^{\infty}\sum_{n=1}^{4}\alpha_{1k}d_{jk}J_1(\alpha_{1k})\exp\left(q_{3-j}\alpha_{2n}x\right),$$

$$\bar{\kappa}_2\frac{d\theta_2^0}{dr}-\frac{d\theta_1^0}{dr}=\zeta\frac{Pe}{\bar{a}_1^2}\left(\frac{\partial T_1}{\partial x}\right)_{r=1}-\lambda R_\lambda\zeta;$$

$$r=s,\quad d\theta_2^0/dr=-Bi_{k,m}\theta_2^0 \qquad (47)$$

Analysing the equations and boundary conditions one must note that physically substantiated