of these axes is shown it should be understood that all four behave identically because of the fourfold symmetry of the [001] axis. For the [111] extremum, which moves in the (110) plane, the sum of Eqs. (3) and (15) with $\phi = \pi/4$ gives

$$E^{001} = K_1(\tfrac{1}{4}\sin^4\theta + \sin^2\theta\cos^2\theta) + \tfrac{3}{2}(\sigma\lambda_{100} - \tfrac{4}{3}\pi M^2)\sin^2\theta + 2\pi M^2. \tag{18}$$

By setting $\partial E^{001}/\partial\theta = 0$, it follows directly that the movement of this extremum is described by

$$\cos^2\theta = \tfrac{1}{3} - (\sigma\lambda_{100} - \tfrac{4}{3}\pi M^2)/K_1. \tag{19}$$

For uniaxial anisotropy with $K_1 < 0$, the extremum is a minimum or easy axis and must be rotated to the normal ($\theta = 0$) and $(\sigma\lambda_{100} - \frac{4}{3}\pi M^2)/K_1 \leq -\frac{2}{3}$. With $K_1 > 0$, the extremum is a hard axis and must be rotated into the plane ($\theta = \pi/2$) and $(\sigma\lambda_{100} - \frac{4}{3}\pi M^2)/K_1 \geq \frac{1}{3}$.

For σ in the (110) plane, the sum of Eqs. (3) and (16) gives

$$E^{110} = K_1(\sin^4\theta\sin^2\phi\cos^2\phi + \sin^2\theta\cos^2\theta) + \tfrac{3}{2}\sigma\lambda_{100} - \tfrac{3}{4}(\sigma\lambda_{100} - \tfrac{4}{3}\pi M^2)\sin^2\theta$$
$$- \tfrac{3}{2}(\sigma\lambda_{111} - \tfrac{4}{3}\pi M^2)\sin^2\theta\sin\phi\cos\phi. \tag{20}$$

By setting $\partial E^{110}/\partial\theta = \partial E^{110}/\partial\phi = 0$, it may be readily shown that the equations controlling the movement of the pertinent extrema are

$$\sin 2\phi = 3(\sigma\lambda_{111} - \tfrac{4}{3}\pi M^2)/2K_1 \text{ for the [100] and [010] axes,} \tag{21}$$

and

$$\cos^2\theta = \tfrac{1}{3} + (\sigma\lambda_{100} + \sigma\lambda_{111} - \tfrac{8}{3}\pi M^2)/2K_1 \text{ for the [111] axis.} \tag{22}$$

In Fig. 2, the conditions for uniaxial anisotropy determined as in the (001) plane case are presented as follows:

for $K_1 < 0$,

$$\left.\begin{array}{ll} (\sigma\lambda_{111} - \tfrac{4}{3}\pi M^2)/K_1 \leq -\tfrac{2}{3} & (\phi = -\tfrac{\pi}{4}) \\ (\sigma\lambda_{100} + \sigma\lambda_{111} - \tfrac{8}{3}\pi M^2)/K_1 \leq -\tfrac{2}{3} & (\theta = \tfrac{\pi}{2}) \end{array}\right. \tag{23}$$

for $K_1 > 0$,

$$\left.\begin{array}{ll} (\sigma\lambda_{111} - \tfrac{4}{3}\pi M^2)/K_1 \geq \tfrac{2}{3} & (\phi = \tfrac{\pi}{4}) \\ (\sigma\lambda_{100} + \sigma\lambda_{111} - \tfrac{8}{3}\pi M^2)/K_1 \geq \tfrac{4}{3} \;. & (\theta = 0) \end{array}\right. \tag{24}$$

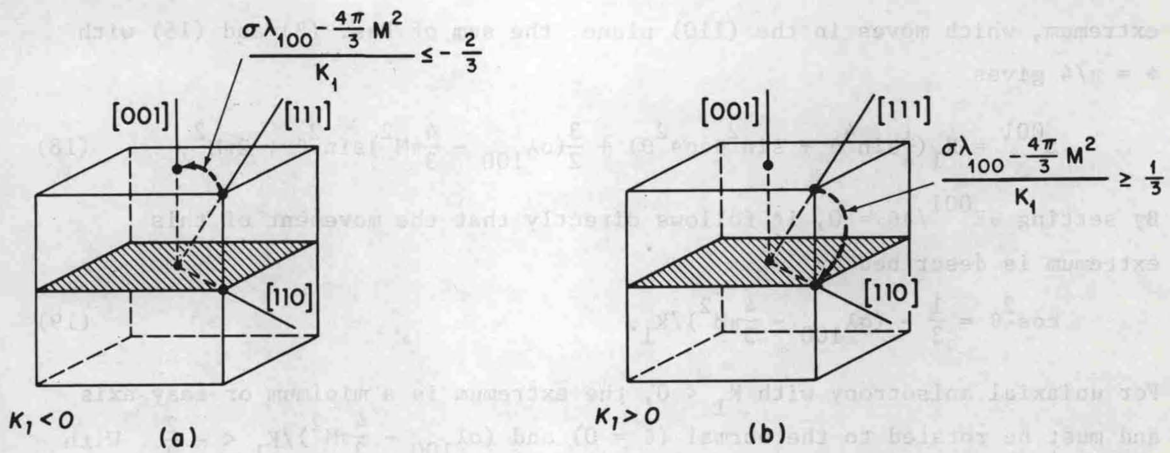

FIG. 1

Movements of important energy extrema and conditions for uniaxial anisotropy with stress in the (001) plane, for (a) $K_1 < 0$ and (b) $K_1 > 0$. Only one of the four is shown with its initial position along the [1$\bar{1}$1] axis (for negligible shape anisotropy).

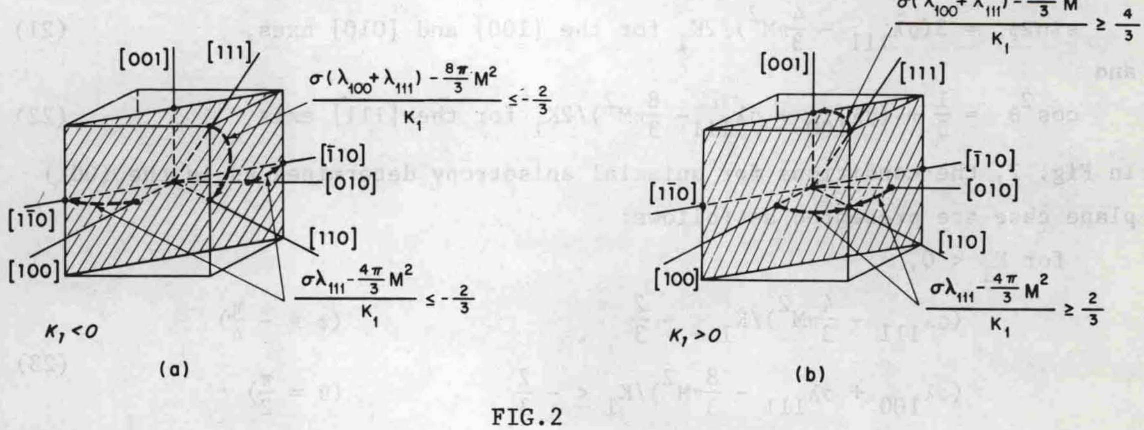

FIG.2

Movements of important energy extrema and conditions for uniaxial anisotropy with stress in the (110) plane, for (a) $K_1 < 0$ and (b) $K_1 > 0$. Initial positions of extrema are shown for the case of neglibible shape anisotropy.

It is evident from Eqs. (23) and (24) that the conditions for anisotropy are more complicated because of the dependence on both magnetostriction con-