level is difficult to determine on account of the thermal acceptors. The acceptor level at 0.018 eV present before doping was absent after doping.

Whelan [3] assigns the copper level at 0.02 eV with a Ga vacancy plus Cu at an internode, in which case it seems that the Au entering the free Ga nodes leads to loss of the Cu level at 0.02 eV and formation of a complex consisting of Au at a Ga node with Cu at an internode, the ionization energy being 0.046 eV.

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CALCULATIONF OF THE EDDY CURRENTS PRODUCED IN A CONDUCTING TUBE MOVING IN A MAGNETIC FIELD

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The results given by Kononkov and Sapozhnikov in No. 6 of this journal for 1963 are not of the general character claimed by the authors; they apply only to certain particular cases.

They considered the motion of a rectangular nonmagnetic tube at a speed v in the field of linear magnetic poles of masses m_1 and m_2 per unit length (Fig. 1); these masses were taken as arbitrary, as were the thicknesses Δ_1 and Δ_2 of the horizontal walls and the specific conductivities σ_1 and σ_2 of these. The vertical walls were taken to be ideal conductors.

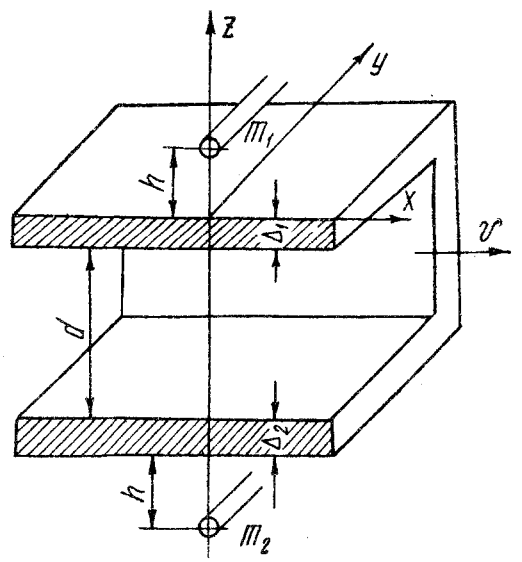

Fig. 1

The magnetic field produced by the eddy currents was found in the two-dimensional approximation (the tube was taken as unbounded along the y axis). It is assumed that the eddy currents have no component along the x axis, so from that point of view the tube may be considered as consisting of mutually insulated transverse frames carrying current G(x). Thus G(x) is taken as the line density of the eddy current, for which purpose they used the relation

$$G(x)\frac{\sigma_2\Delta_2\cdot\sigma_1\Delta_1}{\sigma_1\Delta_1+\sigma_2\Delta_2}=10^8 v\left(\frac{\partial\varphi}{\partial z}\Big|_{z=0}-\frac{\partial\varphi}{\partial z}\Big|_{z=-d}\right), \qquad (1)$$

in which φ is the potential of the magnetic field.

Now (1) is equivalent to the following relation in the three-dimensional case:

$$i=\sigma[vB], \qquad (2)$$

in which i is the volume density of the current and B = −grad φ; this involves the assumption that the potential difference per unit length of circuit is exactly equal to the emf induced in that circuit per unit length.

These assumptions are not valid in the general case envisaged in the original paper (i.e., the m, σ, and Δ arbitrary); this may be demonstrated from the following simple example.

Let $k = m_1/m_2 = -1$ (densities of the magnetic masses equal in magnitude but opposite in sign); then (1) may be used with the expression φ they give to show readily that $G(x) \equiv 0$. This is the natural result of their assumptions, because the emf in the upper wall is equal in magnitude to that in the lower one, but is opposite in sign. They thus consider that there are no eddy currents in this case, but it is easy to show that this is not so.

Ohm's law for the general case of a moving conductor (tube) is

$$j = \sigma (E + [vB]), \qquad (3)$$

in which E is the electric field. We perform the rot operation in both parts of (3) and use the facts that rot $E = -\partial B/\partial t$ and that the magnetic field is stationary ($\partial B/\partial t \equiv 0$) in a fixed frame of reference (as here); this gives

$$\text{rot } j = \sigma \text{ rot } [v B]. \qquad (4)$$

But rot[vB] $\neq 0$, so the current density in the tube is not zero. The current lines are closed in the horizontal walls of the tube (parallel to the xy plane), while the vertical walls (parallel to the xz plane) carry no current. Figure 2 shows a rough approximation for the current lines. The current in each wall is, of course, determined by the Δ and σ of that wall. Arbitrary m, σ, and Δ will cause some of the current lines to encompass the whole tube; the distribution of the eddy currents cannot be found in any simple way, and the derivation of the magnetic field becomes much more complicated.

The assumptions they make, and hence the conclusions they obtain, are correct only when the potential difference per unit length along the y axis is exactly equal to the emf per unit length*.

The system considered here satisfies this requirement if

$$\sigma_1\Delta_1 = \sigma_2\Delta_2, \qquad m_1 = m_2$$

(this corresponds to Steidinger's case for $d \to \infty$, as they state) and if

$$\sigma_2\Delta_2 \to \infty, \qquad m_2 = 0, \qquad d \to \infty.$$

Their solution is thus applicable only to these two particular cases.

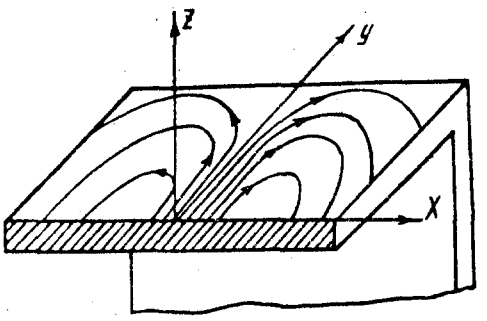

Fig. 2

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PHASE DIAGRAM FOR THE GaAs-Sn SYSTEM

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Alloy junctions and ohmic contacts involve careful control of the depth of the melting. This depth can be calculated for Ge and Si (for a given temperature and weight of metal) from the phase diagram. Similar calculations for $A^{III}B^{V}$ semiconductors are usually not possible on account of lack of phase diagrams. The GaAs-Sn diagram is very important in relation to p-n junctions in GaAs, because Sn is often used in ohmic contacts on n-type GaAs and in rectifying those on p-type GaAs.

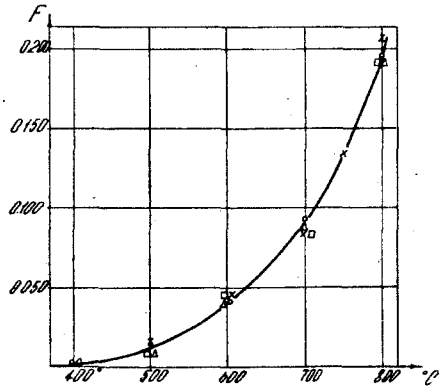

Fig. 1. Solubility F of GaAs in Sn as a function of temperature; $F = v_1/v_2$, where v_1 is the volume of GaAs dissolving in a volume v_2 of Sn.

Figure 1 gives our results [1] on the solubility of GaAs in Sn, which enables us to construct an approximate phase diagram for GaAs-Sn, which is of some interest, because it is difficult to construct the diagram directly from cooling curves on account of irreversible decomposition of GaAs, the equilibrium vapor pressure of As over this being very high [2].

The method of measuring the solubility has already been described [1] and was simply that a monocrystal of GaAs was placed in Sn heated to a given temperature and was left there until no more dissolved. The changes in weight were measured. The experiments were done in air at temperatures between the melting point of tin and 800°C, with precautions to prevent oxidation (a layer of activated charcoal).

*The results of a previous paper by these authors (No. 4 of this journal for 1963) are not open to objection in that respect.