SOV/58-59-5-10700

Translation from: Referativnyy Zhurnal Fizika, 1959, Nr 5, p 118 (USSR)

AUTHOR: Pavlov, V.A.

TITLE: Study of Regularities in Plastic Deformation and Failure

PERIODICAL: Tr. In-ta fiz. metallov. Ural'skiy fil. AS USSR, 1958, Nr 20, pp 245-263

ABSTRACT: Survey of studies executed in the laboratory of mechanical properties of the IFM. The bibliography contains 57 titles.

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SOV/126-6-1-14/33

AUTHORS: Grin', A. V., Pavlov, V. A. and Pereturina, I. A.

TITLE: Influence of Static Distortions of the Crystal Lattice on the Mechanical Properties of Aluminium-Magnesium Alloys (Vliyaniye staticheskikh iskazheniy kristallicheskoy reshetki na mekhanicheskiye svoystva splavov alyuminiya s magniyem)
II Dependence of the Total and of the Uniform Deformation on the Temperature and the Speed of Deformation
(II Zavisimost' polnoy i ravnomernoy deformatsii ot temperatury i skorosti deformirovaniya)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958 Vol 6 Nr 1 pp 110-115 (USSR)

ABSTRACT: The aim of the work described in the first part of this paper (1957, Vol 5, Nr 3, pp 493-500) was to study the influence on the mechanical properties of the static distortions of the crystal lattice which are caused by atoms of the dissolved elements and the diffusion processes taking place as a result of stresses occurring during plastic deformation. Aluminium-magnesium alloys were used in the experiments. Earlier investigations of one of the authors and his team have shown that

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Influence of Static Distortions of the Crystal Lattice on the Mechanical Properties of Aluminium-Magnesium Alloys
II. Dependence of the Total and of the Uniform Deformation on the Temperature and the Speed of Deformation

considerable static distortions of the crystal lattice take place, which are brought about by magnesium atoms but the bond forces do not change the composition of the alloy. Such a combination of properties permits studying in the pure form the influence of crystal lattice distortions on the mechanical properties. The authors investigated the temperature dependence of the yield point and the ultimate strength of pure aluminium (containing about 0.01% Mg, 0.0017% Fe, 0.0014% Si, 0.0011% Cu) and its magnesium alloys (0.05, 0.1, 0.3, 0.5 and 1% Mg) in the temperature range between 80 and 700°K for widely differing deformation speeds ($6.4 \cdot 10^{-3}$, $2 \cdot 10^{-1}$, $2 \cdot 10^{-4}$). It was established that for pure aluminium the temperature dependence of the yield point in the temperature range up to 500°K is determined fundamentally by a change in the interatomic bond forces. At elevated temperatures a more pronounced dependence was detected of the yield point on the temperature which

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SOV/126-6-1-14/33

Influence of Static Distortions of the Crystal Lattice on the Mechanical Properties of Aluminium-Magnesium Alloys
II. Dependence of the Total and of the Uniform Deformation on the Temperature and the Speed of Deformation

is apparently due to deformations along the grain boundaries. Hardening of the aluminium alloys with magnesium is caused by static distortions of the crystal lattice which are brought about by magnesium atoms. The diffusion processes lead to a non-monotonous dependence of the yield point on the temperature, an anomalous dependence on the speed of deformation and a complication of the dependence of the mechanical properties on the composition of the alloy and on the conditions of deformation. Maxima were observed of the yield point in the temperature range of about 500°K and increased values at 80°K which are attributed to various types of diffusion processes taking place in the case of deformation under the effect of stresses. Thus it was found that static distortions of the crystal lattice brought about by the magnesium atoms, cause an increase in the yield point and the ultimate strength. In the

Card 3/6 here published second part of the paper, the authors

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Influence of Static Distortions of the Crystal Lattice on the Mechanical Properties of Aluminium-Magnesium Alloys
II. Dependence of the Total and of the Uniform Deformation on the Temperature and the Speed of Deformation

investigate the total and the uniform deformation of alloys of aluminium with magnesium in the temperature range of 80 to 700°K for the same range of speeds of deformation. They found that the static distortions of the crystal lattice caused by magnesium atoms reduce the plasticity and that the diffusion processes taking place as a result of the stresses during deformation of alloys bring about an increase in the plasticity and complicate the temperature dependence of the total and the uniform elongations. In alloys of aluminium with magnesium, the crystal structure of which has suffered static distortions, a complicated dependence is observed of the total and the uniform elongations on the temperature and the speed of deformations. The plastic properties of such alloys is apparently determined by several factors which act simultaneously, namely: a more uniform distribution of the plastic deformation along the volume of the crystal and an

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SOV/126-6-1-14/33

Influence of Static Distortions of the Crystal Lattice on the Mechanical Properties of Aluminium-Magnesium Alloys
II. Dependence of the Total and of the Uniform Deformation on the Temperature and the Speed of Deformation

increase of the effective volume which participates in the deformation, brings about an increase in the plasticity of the alloys; a diffusion of the atoms of the alloying elements under the effect of stresses taking place during deformation and causing a reduction of the peaks of over-stresses in the neighbourhood of non-uniformities of the crystal lattice and in the neighbourhood of microscopic cracks bring about an increase of the plasticity; an increase of the types II and III distortions during plastic deformation and an increase of the resistance to deformation in the alloys bring about a reduction in the plasticity. Obviously, the interaction of these factors will cause a sufficiently complicated dependence of the uniform and the total elongations on

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SOV/126-6-1-14/33

Influence of Static Distortions of the Crystal Lattice on the Mechanical Properties of Aluminium-Magnesium Alloys
II. Dependence of the Total and of the Uniform Deformation on the Temperature and the Speed of Deformation

the composition of the alloy and the conditions of deformation.
There are 7 figures and 9 references, all of which are Soviet.

ASSOCIATION: Institut fiziki metallov Ural'skogo filiala AN SSSR (Institute of Metal Physics, Ural Branch of the Ac.Sc., USSR)

SUBMITTED: August 11, 1956

1. Aluminum-magnesium alloys--Mechanical properties
2. Crystals--Deformation 3. Crystals--Lattices
4. Crystals--Metallurgical effects

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AUTHOR: Pavlov, V. A. SOV/126-6-1-16/33

TITLE: Internal Lattice Defects Studied from Internal Friction (Izucheniye defektov kristallicheskoy reshetki pri pomoshchi vnutrennego treniya)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 6, Nr 1 pp 122-127 (USSR)

ABSTRACT: Pure Al and Al + 3% Mg were used at or below room temperature; peaks are found in the -50 to -80°C and -170 to -180°C ranges, plus a rise at -196°C. The corresponding activation energies are 0.5, 0.14 and 0.05 eV. Transverse oscillations at 1200-1300 c/s were used, in an apparatus not described (whether vacuum or not is not stated). Round rods 200 mm long and 11 mm in diameter (preparation not described) were used. Figs 1 and 2 show these two peaks for pure Al (1) and the Al alloy (2). Figs. 3 and 4 show rather scanty measurements in the immediate regions of the peaks. Doubt is cast on the dislocation displacement hypothesis since the peak height depends very much on the thermal history. Preference is given to Frenkel's interstitial atoms theory (Ref.16), particularly in relation to the

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Internal Lattice Defects Studied from Internal Friction

rise at very low temperatures. The other two peaks (in order of increasing temperature) may be explainable in terms of diffusion of vacancy accumulations, and of single vacancies respectively. Figs. 5 and 6 show the effects of annealing at 150°C for 3 hours at various times after annealing; the first peak becomes lower and the second higher. This is interpreted as the single vacancies combining.

There are 6 figures and 18 references, 4 of which are Soviet, 14 English.

ASSOCIATION: Institut Fiziki Metallov Ural'skogo Filiala AN SSSR (Institute of Metal Physics, Ural Branch of the Ac Sc USSR)

SUBMITTED: July 26, 1956

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1. Aluminum--Lattices 2. Aluminum--Temperature factors 3. Aluminum-magnesium alloys--Lattices 4. Aluminum-magnesium alloys--Temperature factors

SOV/126-6-2-21/34

AUTHORS: Noskova, N. I. and Pavlov, V. A.

TITLE: Investigation of the Fine Structure of Solid Solutions of Aluminium with Magnesium and of Nickel with Copper (Issledovaniye tonkoy struktury tverdykh rastvorov alyuminiya s magniyem i nikelya s med'yu)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 6, Nr 2, pp 334-338 (USSR)

ABSTRACT: The work described in this paper consists of measuring the static and dynamic distortions of the crystal lattice, determination of the block pattern in the deformed state, measurement of type II distortions and determination of the temperature dependence of the "static" distortions for the solid solution nickel-copper. The following were investigated: 1) pure aluminium containing 0.0017% Fe 0.0011% Si, 0.01% magnesium; alloys of aluminium with 0.12 and 0.04% magnesium.
2) Pure nickel obtained by fusion in a vacuum furnace and alloys containing 10, 20, 40 and 60% copper also produced in a vacuum furnace.
The specimens for investigating the static and the dynamic distortions were produced as follows: powder produced by filing and passed through a sieve was annealed in vacuum,

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SOV/126-6-2-21/34

Investigation of the Fine Structure of Solid Solutions of Aluminium with Magnesium and of Nickel with Copper

whereby the annealing regimes were so chosen (Table 1, p 335) that the extinction effect is eliminated. The annealed powder was glued onto a copper wire of 0.3 mm dia; the specimen diameter was 1.00 ± 0.02 mm. The characteristic temperature of the pure metals and of the solid solutions was determined by decyphering X-ray patterns obtained from the investigated specimens at the temperatures of liquid nitrogen, +20 and +200 °C. For determining the type II distortions and the block pattern, the filings were not annealed; the filing and the exposures for nickel-base alloys were effected at room temperature. Powders of aluminium and of alloys of Al with magnesium were produced by filing at liquid nitrogen temperature, since for the filing carried out at room temperature the type II distortions become eliminated and the X-ray patterns do not reveal any blurred lines with a high degree of reflection. The type II distortions in aluminium and aluminium alloys were determined by using copper K_α-radiation; all the other measurements were effected with a molybdenum K_α-radiation. In the case of nickel specimens, aluminium and

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Investigation of the Fine Structure of Solid Solutions of Aluminium with Magnesium and of Nickel with Copper

zirconium filters (d = 0.22 mm) were used. Calculation was based on the lines with differing index squares (20 for aluminium and its alloys, 24 for determining type II distortions of nickel and its alloys, 68 for determining the characteristic temperature). All the lines were photometered at least three times. Thereby, the accuracy of the characteristic temperature was 3% of the measured value. On the basis of the results, which are graphed and tabulated, the following conclusions are arrived at:

1. In the investigated solid solution the type II distortions increase with increasing content of the second component in the solid solution, whilst the degree of block formation in the deformed state (90% deformation) changes little as a function of alloying.

2. A possible cause of hardening of the solid solutions of aluminium with magnesium is the presence of large static distortions caused by the atoms of the second component.

3. In the solid solutions nickel-copper hardening is observed in spite of the presence of the dynamic

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Investigation of the Fine Structure of Solid Solutions of Aluminium with Magnesium and of Nickel with Copper

distortions (the characteristic temperature as a function of alloying decreases). The latter can be elucidated by the formation in the solid solutions of microscopic non-uniformities which impede the processes of plastic deformation and of relaxation.
There are 3 figures, 3 tables and 7 references, 5 of which are Soviet, 2 German.

ASSOCIATION: Institut fiziki metallov UFAN SSSR (Institute of Metal Physics, Ural Branch of the Ac.Sc., USSR)

SUBMITTED: July 19, 1957

Card 4/4 1. Aluminum alloys--Structural analysis 2. Nickel alloys--Structural analysis 3. Alloys--Production 4. Vacuum furnaces--Applications

SOV/126-6-3-19/32

AUTHORS: Gaydukov, M. G. and P[illegible]lov, V. A.

TITLE: Stress Relaxation in Alloys of Nickel with Copper (Relaksatsiya napryazheniy v splavakh nikelya s med'yu)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 6, Nr 3, pp 517-521 (USSR)

ABSTRACT: In earlier work (Refs 6 and 7) investigations were described of aluminium-magnesium alloys in which the interatomic bond forces did not depend on the concentration of the solid solution and the static distortions of the crystal lattice increased with increasing magnesium content. Increases in the yield point, the ultimate strength and the relaxation stability were observed in such alloys (Refs 1 and 2). Furthermore, diffusion processes of magnesium redistribution inside the volume of the solid solution were observed under load, which brought about a non-monotonous change of the mechanical properties as a function of the temperature and the deformation speed. Such diffusion processes brought about a non-uniform distribution of the magnesium along the volume of the solid solution; this was accompanied by a complication of the elementary act of diffusion and an increase in the [illegible]

SOV/126-6-3-19/32

Stress Relaxation in Alloys of Nickel with Copper

recrystallisation temperature which in turn impeded the development of diffusion plasticity. In nickel-copper alloys there is an intensive drop in the characteristic temperature and the modulus of elasticity decreases (Refs.4 and 5). The static distortions of the crystal lattice are considerable at room temperature but they decrease rapidly with increasing temperature. In copper-rich deformed alloys an increase of the inter-atomic bond forces was observed which is probably due to the non-uniform distribution of the atoms in the volume of the solid solution, caused by diffusion during deformation and holding of the specimens at room temperature after deformation; in these alloys the formation during annealing of the K-state is possible, which is characterised by a non-uniform distribution of atoms of copper in the solid solution (Refs.8,9). Taking into consideration the properties of the nickel-copper alloys, it can be anticipated that intensive diffusion processes take place under load which are accompanied by intensive stress relaxation. However, diffusion during

Card 2/6 stress relaxation will bring about a non-uniform

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Stress Relaxation in ...

...istribution of the ... solution decomposition ... and this will ... the relaxation ... in pure nickel and in stress relaxation ... 10, 20, 40 ... % ... nickel-copper alloys ... which were ... electrolytic nickel ... 0.05% of content of ... melted in vacuum ... was forged into rods of 14 ... cross ... specimens with a test length of 100 ... were ... The specimens were ... selected temperatures ... equal ... designed ... providing ... relaxation ... experiments were ... 500, 550, 600 and 650°C ... initial stress ... 4 kg/mm². In the first case the stress ...

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SOV/126-[illegible]-3-19/32

Stress Rela[illegible] in Al[illegible] of Nickel [illegible]

than the [illegible] point of the alloys [illegible] and, therefore, the stress relaxation [illegible] predominantly by diffusion; in the [illegible] stresses [illegible] the yield point [illegible] relaxation could proceed also by sli[illegible]. The yield point value for the tested alloys [illegible] tures 500, 550, 600 and 650°C are entered [illegible] 1. [illegible] dependence of stress relaxation for an ini[illegible] 2 kg/mm², on the [illegible] of the solid [illegible] given [illegible], Fig.1, expressed in relative [illegible] of the ratio - current stress/initial stress, σ/σ_0; [illegible] curve repres[illegible] the [illegible] relaxation for [illegible] after the beginning of the tests. In Fig.2 [illegible] is graphed of the stress relaxation on the concentration of the solid solution at 500°C and an initial stress of 4 kg/mm²; the strongest proved to be the alloy [illegible] 40% Cu and the fact is worth noting that, as regards the relaxation stability, the alloys [illegible] ord[illegible] in the [illegible] sequence as for the yield point values. The following conclusions are arrived at: depending on the initial value of

Card 4/6 the stress, the stress relaxation can be [illegible]

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Stress Relaxation in Alloys of Nickel with Copper

to sliding deformations or diffusional; if the stress relaxation is predominantly due to the sliding mechanism, those alloys are most stable which have the highest copper content; in the case that the diffusion mechanism is predominant, stress relaxation will be the more pronounced the higher the concentration of admixtures; in the case of diffusion under load, non-uniform distribution of the admixtures in the volume of the solid solution will take place, which is accompanied by work hardening of the copper-rich alloys (40 to 60% Cu) during the process of relaxation. In an appendix, the work of Kester and Schulle, Zs. Metallkunde, 1957, 48, 592 is quoted; these authors found that there was a change in the properties of the nickel alloy containing 55% Cu after annealing in the temperature range below 650°C which is attributed to the occurrence of near-ordering in this temperature range. It is stated that these data confirm the assumption of the authors of this paper of the possibility of hardening of the alloy during stress

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Stress Relaxation in Alloys of Nickel with Copper

relaxation as a result of near-ordering.
There are 2 figures, 1 table and 10 references, 8 of which are Soviet, 1 English, 1 German.

ASSOCIATION: Institut fiziki metallov Ural'skogo filiala AN SSSR (Institute of Metal Physics, Ural Branch of the Ac.Sc., USSR)

SUBMITTED: July 26, 1957

1. Copper-nickel alloys--Physical properties 2. Copper-nickel alloys --Diffusion 3 Copper-nickel alloys--Stresses 4. Copper-nickel alloys--Temperature factors

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SOV/126-6-4-21/34

AUTHORS: Pavlov, V.A.,
Pereturina, I.A.

TITLE: Mechanical Properties of the Nickel-Copper Alloys (Mekhanicheskiye svoystva splavov nikelya s med'yu)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 6, Nr 4, pp 717-724 (USSR)

ABSTRACT: The effect of the temperature and the rate of deformation on the yield point, σ, of pure nickel and its alloys containing 10, 20, 40 and 60% copper was investigated. High purity (99.99%) electrolytic nickel and electrolytic copper with less than 0.05% impurities, both degassed by re-melting in a vacuum of 10^{-5} mm Hg, were used for the preparation of the experimental alloys melted in vacuum. The ingots were forged into 10 x 10 mm rods whose size was then reduced to 5 x 5 mm by rolling. This was followed by several wire-drawing operations with intermediate anneals. The conditions of the final heat treatment were adjusted so as to obtain the same grain size (approx 0.1 mm) in all the investigated alloys. The tensile tests were carried out on wire test pieces (1 mm diameter, 55 mm long) at temperatures ranging

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SOV/126-6-4-2/30

Mechanical Properties of the Nickel-Copper Alloys

from -196 to + 700°C and at three rates of strain: 2×10^{-4}, 6.4×10^{-3} and 2×10^{-1} cm/sec. The graphs showing the temperature dependence of σ of pure nickel and its alloys deformed at various rates of strain are reproduced in Fig.1, 2 and 3. The variation of σ of pure nickel with temperature is very small up to 600°K, while above this temperature it decreases exponentially. (The ln σ versus 1/T graph is shown in Fig.4) It is easy to show that the temperature dependence of σ in the low temperature region is determined mainly by the variation of the atomic bond forces with the temperature: Graph 1 in Fig.5 shows the temperature dependence of the yield point/elastic modulus ratio (σ/E) for polycrystalline nickel. It can be seen that up to 600°K this ratio remains practically constant. (In the case of a single nickel crystal, the temperature interval within which σ varies little with temperature is even wider, as is shown by graph 2 in Fig.5 which represents the temperature dependence of τ/E, where τ is the critical shear stress). This effect which has been also observed

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Mechanical Properties of the Nickel-Copper Alloys

in aluminium (Ref.2, 11), copper (Ref.12) and gold (Ref.10) appears to be a characteristic of metals with the face-centred cubic crystal lattice. The yield point of the Ni-Cu alloys is higher than that of pure nickel and reaches its maximum value at 40% Cu (Fig.2). The fact that σ of all alloys is greatly affected by temperature cannot be explained by the variation of the atomic bond forces with temperature: The temperature dependence of σ/E of three alloys deformed at the same rate of strain is shown in Fig.6, and it is quite apparent that this ratio depends to a considerable degree on the temperature at which the alloy is being deformed. In addition, the variation of σ with the temperature is not monotonic: The σ/T graphs show two maxima, one in the high temperature range, the other approx 200°K. The magnitude and location of these maxima depend on the composition of the alloy and on the rate of strain. In general, the magnitude of the critical point (U.T.S.) increases with increasing copper content up to 40% Cu and then decreases. However, more careful examination of the strain/stress curves reveals that the increase

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Mechanical Properties of the Nickel-Copper Alloys

of U.T.S. is associated mainly with the increase of the yield point: If the strain/stress curves of the investigated alloys are drawn together in such a way that the yield point coincides with the origin of the co-ordinates, it is seen that the increase of the stress due to strain hardening is less in the nickel alloys than in pure nickel (Fig.7). The experimental results are correlated with those obtained by other workers and the following conclusions are reached:

(i) The variation of the atomic bond forces and static lattice distortions cannot account for the increased strength of the Ni-Cu alloys, since the former decrease with the rising Cu content, while the lattice distortions at temperatures higher than 300°C are quite small.

(ii) The increased strength of the investigated alloys is caused mainly by non-uniform distribution of the atoms of the alloying element in the solid solution. It is postulated on the basis of the experimental results that there are three possible causes of non-uniform

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SOV/126-6-4-21/34

Mechanical Properties of the Nickel-Copper Alloys

distribution of the solute atoms: (a) High concentration of the atoms of the alloying element at the grain and sub-grain boundaries, (b) Formation of solute atom "clouds" around the dislocations, (c) Short-range order i.e. deviation from the statistical distribution of the solute atoms in the solid solution.

(iii) The yield point of pure nickel consists of two components: One due to shear within the grains whose value changes very slightly with the temperature and the other due to shear along the grain boundaries, the temperature dependence of which is approximately exponential.

(iv) From the non-monotonic character of the temperature dependence of σ, and from the effect of the rate of strain on this relationship, the diffusion character of

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Mechanical Properties of the Nickel-Copper Alloys

the interaction between dislocations and the solute atoms (or groups of atoms) can be inferred. There are 9 figures and 30 references of which 18 are Soviet, 10 English and 2 German.

ASSOCIATION: Institut Fiziki Metallov Ural'skogo Filiala AN SSSR (Institute of Metal Physics, Ural Branch of the AS USSR)

SUBMITTED: 5th August 1958.

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SOV/126-6-5-21/43

AUTHORS: Datsko, O. I., and Pavlov, V. A.

TITLE: Temperature Dependence of the Internal Friction in Pure Nickel (Temperaturnaya zavisimost' vnutrennego treniya chistogo nikelya)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 6, Nr 5, pp 900-904 (USSR)

ABSTRACT: The authors used electrolytic nickel of 99.987% purity. Ingots of nickel were rolled and drawn at room temperature in several stages until a wire of 0.80 mm dia. was produced. In between the forming stages the samples were annealed at 800°C in vacuo. After the last anneal the wire was deformed by 80% reduction of its cross section and cut into 300 cm lengths. The temperature dependence of the internal friction was determined by means of a torsional pendulum oscillating at 0.5 c/s in 10^{-3} - 10^{-4} mm Hg vacuum. The following procedure was applied in each set of measurements: a sample was heated at 2°C/min to 700-900°C and then cooled slowly to room temperature by switching off the furnace and leaving the sample in it. After each such anneal the temperature dependence of the internal friction was measured and recorded. In the first

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Temperature Dependence of the Internal Friction in Pure Nickel

heating of a deformed sample to 700°C or more, recrystallisation occurred at 400°C. Each subsequent heating produced collective recrystallisation. Fig.1 shows the temperature dependence of the internal friction of nickel as a function of the anneal temperature. Curves 1-5 in Fig.1 represent the results obtained by short anneals at 700, 750, 800, 850 and 900°C respectively, while curve 6 is the result of a 3-hour anneal at 900°C. Fig.2 gives the temperature dependence of the internal friction of nickel as a function of deformation by 1% (curve 1) and subsequent short anneals at 700°C (curve 2), 800°C (curve 3), 900°C (curve 4), and a 3-hour anneal at 900°C (curve 5). Fig.3 presents data, analogous to those of Fig.2 for 2% deformation (curve 2) and subsequent anneals at 900°C (short anneal, curve 3 and 3-hour, curve 1). Fig.4 shows the effect of addition of 0.023% (curve 1), 0.05% (curve 2) and 0.24% (curve 3) of aluminium on the temperature dependence of the internal friction of nickel. The authors make the following conclusions.

1. The internal friction peak at 440-460°C is due to

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Temperature Dependence of the Internal Friction in Pure Nickel

relaxation stresses along grain boundaries. This peak decreases in amplitude and is slightly displaced towards higher temperatures on increase of the annealing temperature. This is due to the increase of the grain size and the change in properties of the grain boundaries on collective recrystallisation.

2. The internal friction peak at 630-800°C is due to relaxation of stresses on mosaic block boundaries. It increases in amplitude and is displaced towards lower temperatures by plastic deformation. Increase of the temperature of anneals carried out after deformation displaces this peak towards higher temperatures and reduces its amplitude. This behaviour is due to processes of growth and reduction in size of the mosaic blocks, which are accompanied by changes in the properties of the block boundaries. The 630-800°C peak disappears when a foreign metal (e.g. aluminium) is added to nickel (Fig.4).

There are 5 figures and 14 references, 4 of which are Soviet, 6 English, 2 German, 1 French and 1 translation from English.

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Temperature Dependence of the Internal Friction in Pure Nickel

ASSOCIATION: Institut fiziki metallov Ural'skogo filiala AN SSSR (Institute of Metal Physics, Ural Branch of the Ac.Sc., USSR)

SUBMITTED: August 8, 1957

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PAVLOV, V.A.

24(6) PHASE I BOOK EXPLOITATION SOV/2395

Akademiya nauk SSSR

Nekotoryye problemy prochnosti tverdogo tela; sbornik statey (Some Problems in the Strength of Solids; Collection of Articles) Moscow, Izd-vo AN SSSR, 1959. 386 p. Errata slip inserted. 2,000 copies printed.

Ed. of Publishing House: V. I. Aver'yanov; Tech. Ed.: R. S. Pevzner; Editorial Board: A.F. Ioffe, Academician; G. V. Kurdyumov, Academician; S. N. Zhurkov, Corresponding Member, USSR Academy of Sciences; B. P. Konstantinov, Corresponding Member, USSR Academy of Sciences; F. F. Vitman, Doctor of Physical and Mathematical Sciences, Professor (Resp. Ed.); L. A. Glikman, Doctor of Technical Sciences, Professor; B. A. Zlatin, Doctor of Physical and Mathematical Sciences; V. A. Stepanov, Doctor of Technical Sciences; Ya.B. Fridman, Doctor of Technical Sciences, Professor; B. S. Ioffe, Candidate of Technical Sciences (Deputy Resp. Ed.).

PURPOSE: This book is intended for construction engineers, technologists, physicists and other persons interested in the strength of materials.

COVERAGE: This collection of articles was compiled by the Otdeleniye fiziko-matematicheskikh nauk AN SSSR (Department of Physical and Mathematical Sciences) and the Fiziko-tekhnicheskiy institut AN SSSR (Institute of Applied Physics, Academy of Sciences, USSR) in commemoration of the 80th birthday of Nikolay Nikolayevich Davidenkov, Member of the Ukranian Academy of Sciences, founder and head of the Otdel prochnosti materialov (Department of the Strength of Materials) at the Institute of Applied Physics, Academy of Sciences, USSR, founder of the Fakul'tet fizicheskogo metallovedeniya (Department of Physical Metallurgy) at the Leningradskiy politekhnicheskiy institut (Leningrad Polytechnic Institute), recipient of the Stalin Prize (1943), the Order of the Red Banner of Labor (1945) and the Order of Lenin (1953). The articles deal with the strength of materials, phenomena of imperfect elasticity, temper brittleness, hydrogen embrittlement, cold brittleness, influence of deformation speed on the mechanical properties of materials, fatigue of metals, and general problems of the strength, plasticity, and mechanical properties of nonmetals. Numerous personalities are mentioned in the introductory profile of Professor Davidenkov. References are given at the end of each article.

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PAVLOV, V.A.

PHASE I BOOK EXPLOITATION SOV/3559

Akademiya nauk SSSR. Institut metallurgii. Nauchnyy sovet po probleme zharoprochnykh splavov

Issledovaniya po zharoprochnym splavam, t. 5 (Investigations of Heat-Resistant Alloys, Vol 5) Moscow, Izd-vo AN SSSR, 1959. 425 p. Errata slip inserted. 2,000 copies printed.

Ed. of Publishing House: V.A. Klimov; Tech. Ed.: I.F. Kuz'min; Editorial Board: I.P. Bardin, Academician, G.V. Kurdyumov, Academician, N.V. Ageyev, Corresponding Member, USSR Academy of Sciences (Resp. Ed.), I.A. Oding, I.M. Pavlov, and I.F. Zudin, Candidate of Technical Sciences.

PURPOSE: This book is intended for metallurgical engineers, research workers in metallurgy, and may also be of interest to students of advanced courses in metallurgy.

COVERAGE: This book, consisting of a number of papers, deals with the properties of heat-resisting metals and alloys. Each of the papers is devoted to the study of the factors which affect the properties and behavior of metals. The effects of various elements such as Cr, Mo, and W on the heat-resisting properties of various alloys are studied. Deformability and workability of certain metals as related to the thermal conditions are the object of another study described. The problems of hydrogen embrittlement, diffusion and the deposition of ceramic coatings on metal surfaces by means of electrophoresis are examined. One paper describes the apparatus and methods used for growing monocrystals of metals. Boron-base metals are critically examined and evaluated. Results are given of studies of interatomic bonds and the behavior of atoms in metal. Tests of turbine and compressor blades are described. No personalities are mentioned. References accompany most of the articles.

SOV/180-59-1-21/29

AUTHORS: Izbranov, P.D., Pavlov, V.A. and Rodigin, N.M.(Sverdlovsk)

TITLE: Investigation of the Orientation of Recrystallization Centres at High Rates of Heating (Issledovaniye oriyentatsii tsentrov rekristallizatsii pri bol'shikh skorostyakh nagreva)

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Metallurgiya i toplivo, 1959, Nr 1, pp 109-110 + 1 plate (USSR)

ABSTRACT: The authors suggest that more reliable results on recrystallization can be obtained through investigation of the orientation of centres at high heating rates than at the low rates used in most work. They go on to describe their investigation of the recrystallization of cold-rolled specimens of a 3.54% Si steel. One batch of test pieces was 75% reduced, the other by 95%. The 15x100x0.25 mm strip specimens were heated either by the passage of electricity, in Rodigin's apparatus (Ref 4), or by immersion in a hot salt bath and air cooled. The cold-deformed and recrystallized specimens were examined microscopically and their texture was determined by the X-ray method. Fig 1 shows the X-ray pattern obtained from a cold-deformed specimen, Fig 2 that from one

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Investigation of the Orientation of Recrystallization Centres at High Rates of Heating

recrystallized by heating electrically at 1100°C per sec. to 770°C, Fig 3 that from one immersed for about two seconds in a salt bath at 770°C. Fig 4 shows the structure obtained with the latter procedure. The X-ray patterns obtained with longer heating times in the salt bath are shown in Figs 5 and 6 (5 and 20 sec. respectively). The investigation showed that in recrystallization of strongly-deformed transformer steel (with a very pronounced deformation texture) the greatest probability of generation is possessed by those recrystallization centres whose orientation fully coincides with that of the deformed crystal sections. This leads to the first texture coinciding with the deformation texture. The second texture, which is that normally observed in the deformation of transformer steel, appears later in the development of recrystallization. The rates of heating

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Investigation of the Orientation of Recrystallization Centres at High Rates of Heating

used had no appreciable effect on the mechanism of the formation of new grains on recrystallization.

There are 6 figures and 7 references, 5 of which are Soviet and 2 French.

SUBMITTED: August 7, 1958

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66389

SOV/58-59-10-22722

18.1210

Translation from: Referativnyy Zhurnal, Fizika, 1959, Nr 10, pp 134 - 135 (USSR)

AUTHORS: Gaydukov, M.G., Pavlov, V.A.

TITLE: Creep of Aluminum-Magnesium and Nickel-Copper Solid-Solution Alloys

PERIODICAL: Tr. In-ta fiz. metallov. AN SSSR, 1959, Nr 22, pp 107 - 112

ABSTRACT: The authors studied creep in Al-Mg alloys at temperatures of 150° to 400°C and stresses of 2 and 0.3 kg/mm^2, and in Ni-Cu alloys at temperatures of 500° to 700°C and stresses of 5 and 2 kg/mm^2. They established that the solid-solution concentration dependence of the creep rate varies with a variation in temperature and active stresses This is explained from the point of view of a variation in the ratio of participation of shearing and diffusion mechanism of plastic deformation under various conditions of deforming.

The authors' résumé

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SOV/126-7-2-14/39

24(6), 18(7)

AUTHORS: Gaydukov, M. G. and Pavlov, V. A.

TITLE: Dependence of Creep of Al-Mg Alloys on Temperature and Applied Stress (Zavisimost' polzuchesti splavov Al-Mg ot temperatury i velichiny prilozhennykh napryazheniy)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1959, Vol 7, Nr 2, pp 254-258 (USSR)

ABSTRACT: Alloys of Al (99.99% purity) and 0.12, 1.11 and 2.20% Mg were made in a high frequency furnace. The ingots were forged into rods, from which specimens were made, with a working part length of 50 mm, a diameter of 8 mm, and threaded ends. In order to ensure an equal grain size for all alloys (0.16 mm), the specimens were annealed at temperatures specially selected for each alloy in the temperature range 440-460°C. The temperature was kept constant automatically within ± 2°C, and was measured by two thermocouples attached to the specimen. The duration of testing was up to 200 hours. In Figs 1 and 2, creep curves for pure aluminium and an aluminium alloy containing 0.12% Mg are shown, from which it can be seen that alloying of Al with even a small quantity of Mg considerably increases its strength. The strength increases further with increase in Mg content. This can

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Dependence of Creep of Al-Mg Alloys on Temperature and Applied Stress

be seen from the creep curves of Fig 3. In Fig 4 the change in the logarithm of the creep rate with change in composition at 150-350 °C and an acting stress of 2 kg/mm^2, is shown graphically. In Fig 5 curves for the change in the logarithm of the creep rate with concentration of the solid solution at 250-400 °C at a stress of 0.3 kg/mm^2, are shown. Comparing the curves of Figs 4 and 5, it can be seen that as the deformation stress changes, the dependence of the strength of alloys on concentration changes considerably. From the above experiments the authors have arrived at the following conclusions:

1. As a result of alloying aluminium with magnesium, the greatest strengthening of alloys is observed when the plastic deformation mechanism is a shearing one.
2. At low deformation rates and relatively high temperatures, the effect of strengthening the alloys decreases considerably due to development of diffusion plastic deformation, which is associated with the diffusion of magnesium atoms under the action of heat and the deformation stresses applied.

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SOV/126-7-2-14/39

Dependence of Creep of Al-Mg Alloys on Temperature and Applied Stress

There are 5 figures and 11 references, 7 of which are Soviet, 4 English.

ASSOCIATION: Institut fiziki metallov AN SSSR (Institute of Metal Physics, Ac. Sc. USSR)

SUBMITTED: June 10, 1958

Card 3/3

67719

18.1250

SOV/126-7-3-15/44

AUTHORS: Noskova, N. I. and Pavlov, V. A.

TITLE: X-Ray Study of Distortions and Bond Forces in the Crystal Lattice of Nickel-Base Solid Solutions (Rentgenograficheskoye izucheniye iskazheniy i sil svyazi kristallicheskoy reshetki tverdykh rastvorov na osnove nikelya)

PERIODICAL: Fizika metallov i metallovedeniye, Vol 7, Nr 3, pp 400-404 (USSR)

ABSTRACT: In this work static and dynamic distortions caused by alloying have been measured in relation to heat treatment and plastic deformation, and the block formation and secondary distortions in the deformed state have been determined. Solid solutions obtained by alloying nickel (99.99%) with copper (99.95%) and aluminium (99.99%) were studied. The composition of the solid solutions investigated is given in Table 1. All solid solutions were melted in a vacuum furnace. The static and dynamic distortions were determined by a method described in Refs.7 and 8. The block size and the extent of secondary distortions in the deformed state were determined by a method similar to that applied by Lysak (Refs.9 and 10). The method of preparation of the specimens

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SOV/126-7-3-15/44

X-Ray Study of Distortions and Bond Forces in the Crystal Lattice of Nickel-Base Solid Solutions

for investigation has been described in Ref.2. The results of a study of the fine structure of solid solutions of nickel with 10, 20, 40 and 60% Cu are partly published in Ref.2. The characteristic temperature, and the magnitude of static and dynamic distortions of the crystal lattice of these solid solutions are given in Table 2. The nickel-aluminium solid solutions in powder form were annealed prior to investigation. The annealing specifications are indicated in Table 3. Subsequently the static and dynamic distortions of the crystal lattice and the characteristic temperature were determined. The results are given in Table 3. The physical nature of hardened one-phase solid solutions is not absolutely clear yet. In the present work the influence of plastic deformation on the fine structure has been studied by deforming the above solid solution by filing at room temperature. This method of deformation has been chosen for its convenience for X-ray investigation. Specimens were made from the powder for taking X-ray pictures by the Debye method. X-ray pictures were taken at room

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X-Ray Study of Distortions and Bond Forces in the Crystal Lattice of Nickel-Base Solid Solutions

temperature and at the temperature of liquid nitrogen with the aim of establishing the characteristic temperature of the specimens in the deformed state. X-ray pictures were taken of annealed and deformed specimens in K_α -molybdenum irradiation. Besides the secondary distortions and the block size in deformed specimens of nickel-aluminium, solid solutions were also determined by exposure to K_α -iron irradiation. The results of the investigation are shown in Table 4. As a result of the above experiments the authors arrived at the following conclusions.

1. When solid solutions form by alloying nickel with lead and aluminium, static distortions arise, the magnitude of which increases with alloying (within the range of the additions investigated). The characteristic temperature rises on alloying nickel with aluminium, and drops on alloying nickel with copper.

2. Plastic deformation (by filing) at room temperature lowers the characteristic temperature of nickel alloys containing 2.93% aluminium, but raises it in a nickel alloy containing 40% copper.

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X-Ray Study of Distortions and Bond Forces in the Crystal Lattice of Nickel-Base Solid Solutions

3. For under-load processes the possibility of raising or lowering the characteristic temperature must be taken into consideration.
There are 4 tables and 14 references, of which 11 are Soviet, 1 English and 2 German.

ASSOCIATION: Institut fiziki metallov AN SSSR (Institute of Physics of Metals, Ac. Sc., USSR)

SUBMITTED: July 23, 1958

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66231
SOV/126-8-3-15/33

18.1250, 18.8200, 18.7520

AUTHORS: Pavlov, V.A. and Pereturina, I.A.

TITLE: Mechanical Properties of Nickel-Aluminium Alloys

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 8, Nr 3, pp 417-425 (USSR)

ABSTRACT: In the present work results are given of an investigation of the relationship between the UTS on the one hand and alloy composition and conditions of deformation on the other, of nickel-aluminium solid solutions. These alloys are characterized by the fact that their modulus of elasticity, characteristic temperature and static distortion of the crystal lattice increase with increase in alloy concentration. A considerable part of the increase in interatomic bond force appears to be associated with the existence of close order, as during plastic deformation at room temperature the characteristic temperature decreases, approaching the value of pure nickel (Ref 3). The alloys were melted from the high purity electrolytic nickel N0000 and the aluminium AV000 in a vacuum of 10^{-5} mm Hg. The ingots were homogenized and forged into rods, 10 x 10 mm. The billets were planed to a depth of 0.5 to 1.0 mm in order to remove the

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SOV/126-8-3-15/33

Mechanical Properties of Nickel-Aluminium Alloys

surface layer and subsequently rolled and drawn into wires of approximately 1 mm diameter. Wire drawing was carried out at room temperature with the application of several intermediate annealing treatments in vacuum at 800°C. After the last intermediate anneal, the wires were given a deformation of 80% reduction in area and in this state were allowed to recrystallize in the temperature range 850 to 1000°C in vacuum. The recrystallization temperature for each alloy was selected so as to ensure equal grain size for all alloys. The linear grain size in all alloys was approximately 0.1 mm. The specimens were pulled in a special machine and the temperature was varied from 77 to 973°K. The deformation rate at the same time increased 300 times. Fig 1 shows the curves for the temperature dependence of the UTS of pure nickel and nickel alloys containing 0.025, 0.05, 0.5, 1.5 and 2.93% Al. Fig 2 shows curves for the dependence of the UTS on the concentration of the solid solution for two deformation rates, differing by a factor of 300. Fig 3 shows the difference in UTS at -196 and 100°C varying with Al content. Fig 4 shows a curve for the change in UTS in

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SOV/126-8-3-15/33

Mechanical Properties of Nickel-Aluminium Alloys

relation to the reciprocal of temperature for low temperatures of deformation (from 77 to 600°K). The authors arrive at the following conclusions: On alloying nickel with aluminium, the solid solution increases in strength except for low concentration regions in which an initial decrease in UTS is observed. As the concentration of the solid solution increases, the dependence of the UTS on temperature and deformation rate increases. In alloys containing 1.5 and 2.93% Al, an uneven relationship between UTS and temperature exists. The experimental results of the present work, as those of investigations of other alloys in preceding papers, show that the chief reason for the strengthening of alloys on plastic deformation by slip is a change in the nature of the fine structure of the solid solution, which leads to a fuller employment of the interatomic forces in the bond. The fact that UTS is dependent to a greater measure on temperature and deformation rate in the case of alloys than it is in that of pure metals, and also the uneven temperature dependence, show that in the investigated solid solutions thermally activated processes occurring

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Mechanical Properties of Nickel-Aluminium Alloys SOV/126-8-3-15/33

during deformation influence the development of plastic deformation by slip. There are 4 figures and 21 references, 6 of which are Soviet and 15 Western.

ASSOCIATION: Institut fiziki metallov AN SSSR (Institute of Metal Physics AS USSR)

SUBMITTED: August 21, 1958

Card 4/4

66232
SOV/126-8-3-16/33

18.1250, 18.8200

AUTHORS: Gaydukov, M.G. and Pavlov, V.A.

TITLE: Dependence of Creep of Nickel-Copper Alloys on Solid Solution Concentration and Deformation Conditions

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 8, Nr 3, pp 426-433 (USSR)

ABSTRACT: The aim of the present investigations was to study the influence of change of concentration of nickel-copper alloys on their creep behaviour under conditions when plastic deformation occurs preferentially, either by slip or by a diffusion mechanism. Nickel-copper alloys were made at the Special Alloys Laboratory of the Institute of Metal Physics in a high frequency furnace under a vacuum of 10^{-5} mm Hg. Electrolytic nickel N0000 (99.99% Ni) and electrolytic copper with a total impurity content of less than 0.05% (among them 0.02% oxygen) were the starting materials. Nickel and copper were first re-melted in vacuum in order to remove gases. The ingots were forged into rods of 18 mm diameter, from which specimens with threaded heads were ground. The diameter of the working part of the specimens was 6 mm and the calculated length 50 mm. The specimens were

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SOV/126-8-3-16/33

Dependence of Creep of Nickel-Copper Alloys on Solid Solution Concentration and Deformation Conditions

annealed at specially selected temperatures in the range 800 to 900°C in order to obtain approximately equal grain size in all alloys. Testing was carried out on TsKTI-2 machines. During testing, the temperature was kept constant within 2° and was measured by two thermocouples affixed to the specimen. The time of testing reached 500 hours in individual cases. In order to study the behaviour of alloys under conditions of deformation by slip and by diffusion, appropriate temperatures and deformation stresses were selected. In order to ensure a preferential plastic deformation by slip during creep, tests were carried out at relatively low temperatures and high deformation stresses. Preferential plastic deformation by diffusion could be ensured by using high temperatures and low stresses. The values of UTS of pure nickel and Ni-Cu alloys are shown in the table on p 428 (Ref 9). In Fig 1 to 3, curves are shown for the change in deformation, obtained at the moment of loading and after definite creep time intervals, with increase in alloy concentration for a temperature of 500°C and with

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Dependence of Creep of Nickel-Copper Alloys on Solid Solution Concentration and Deformation Conditions

change in acting stresses (9, 2 and 5 kg/mm^2 respectively). Similar curves are obtained at 600°C at deformation stresses of 5 kg/mm^2 (Fig 4). From the results of testing of several specimens of each alloy under identical conditions (testing temperature and stress) the average deformation rates in the steady portion of the creep curves were calculated. In Fig 6 and 7, these results are plotted within the coordinates lg deformation rate - alloy composition, for temperatures of 500, 600 and 700°C and two deformation stresses. In Fig 8, the values of external stresses persisting after relaxation for 84 hours are plotted against two initial stresses σ_0 (2 and 4 kg/mm^2 respectively). The authors arrive at the following conclusions: (1) The creep rate of Ni-Cu alloys in the temperature range 500 to 700°C depends on the composition of the alloy and the conditions of deformation. (2) At relatively low temperatures and high deformation stresses, commensurate with UTS, at which deformation most probably occurs preferentially by the slip mechanism, the creep

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Dependence of Creep of Nickel-Copper Alloys on Solid Solution Concentration and Deformation Conditions

rate is inversely dependent on the UTS. The higher the UTS, the lower the creep rate. Under these conditions of deformation, alloys containing 40% Cu possess the greatest strength. (3) At high temperatures and sufficiently low deformation stresses (stresses considerably lower than the UTS) diffusion processes occurring under the influence of stress play the decisive role. In this case the creep rate increases with increase in the concentration of the solid solution. (4) In a general case the behaviour of alloys under load is determined by the extent to which each of the two, plastic deformation by slip and that by diffusion, are involved. There are 8 figures, 1 table and 12 references, 8 of which are Soviet, 3 German and 1 French.

ASSOCIATION: Institut fiziki metallov AN SSSR (Institute of Metal Physics AS USSR)

SUBMITTED: August 2, 1958

Card 4/4

66233

18.1141, 18.7500

SOV/126-8-3-17/33

AUTHORS: Izbranov, P.D., Pavlov, V.A. and Rodigin, N.M.

TITLE: Some Peculiarities of Transformer-Steel Recrystallization During Rapid Heating. II. Kinetics of Texture Formation

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 8, Nr 3, pp 434-439 (USSR)

ABSTRACT: Much work (Ref 1 to 8) on recrystallization, particularly that of transformer steel, has been carried out on specimens subjected to isothermal recrystallization annealing for times occasionally as long as several hours. The object of the present work was to study the formation and development of the recrystallization texture of transformer steel at high heating rates. A steel with 3.54% Si with a reduction of 75 or 95% was used. 15 x 100 x 0.25 mm specimens were heated by an electric current without holding; others, 0.11 mm thick, by immersion in a salt bath at the required temperature. The electric heating was effected in the apparatus designed by N.M.Rodigin (Ref 10). The microstructure and texture of recrystallized specimens were studied, using a special camera, enabling the specimen to be displaced in two mutually perpendicular directions during exposure.

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Some Peculiarities of Transformer-Steel Recrystallization During Rapid Heating. II. Kinetics of Texture Formation

SOV/126-8-3-17/33

X-Ray patterns obtained are shown in Figures 1 to 4 and 6 to 9, and the microstructure in Fig 5. The authors draw the following main conclusions. Two types of texture arise in the recrystallization of transformer steel. For the highly deformed material, the texture of the first stage of recrystallization conforms to the pronounced deformation texture; later this is replaced by the texture generally found in isothermal annealing of transformer steel. The heating rates (840 to 1170°C/sec) and current densities used had no appreciable effect on the mechanism of formation of new grains as regards orientation factors. The high recrystallization rates obtained by both methods of heating can be attributed to the considerable reduction in relaxation before recrystallization and, possibly, also to the redistribution of impurities. On rapid electric heating to temperatures over 1000°C, the texture produced is substantially the same as the recrystallization texture in isothermal

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18.1141
18.7500

67695
SOV/126-8-4-17/22

AUTHORS: Izbranov, P.D., Pavlov, V.A., and Rodigin, N.M.

TITLE: Some Peculiarities of Transformer Steel Recrystallization on Rapid Heating. III. Dependence of the Rate of Grain Growth and Activation Energy of this Growth on the Rate of Heating

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 8, Nr 4, pp 607-612 (USSR)

ABSTRACT: The high rates of recrystallixation of cold-deformed metals, particularly transformer steels on rapid heating has been explained (Refs 1, 2) in terms of a change in the condition of the metal before recrystallization. This should affect the rate and activation energy of grain growth and it was the object of the present work to determine these parameters for both rapid and slow heating of transformer steel and compare the results together and with published (Refs 3-6) work in this field. The steel used contained 0.08% carbon, 3.54% silicon, 0.15% manganese, 0.018% sulphur, and 0.10% chromium. For rapid-heating experiments the material is subjected to mechanical and heat treatment to give an average grain size of 2-3 mm and a reduced number of recrystallization

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SOV/126-8-4-17/22

Some Peculiarities of Transformer Steel Recrystallization on Rapid Heating. III. Dependence of the Rate of Grain Growth and Activation Energy of this Growth on the Rate of Heating

centres. This involved 40% reduction of the initially 0.5 mm thick strip, followed by 2-3% cold reduction and a further small (given 10% elongation) cold reduction. The specimens were subjected to electric heating to various temperatures (1000-1360 °C) and then air cooled. The average size of the ten largest isolated grains produced in the recrystallization was determined. This is plotted against heating temperature in Fig 1, while the logarithm of grain size is seen to be linearly related (Fig 2) to the inverse of absolute temperature. The activation energy is 13500 ± 2500 cal/mol. The temperature is shown in Fig 3 as a function of heating time. Another series of experiments was carried out with slow heating; the specimens, prepared as before, being heated after 10% deformation in an ordinary furnace to 870 °C at 0.2°C/second and then annealed in a salt bath at that temperature for 45 minutes. The average size of the 20 largest isolated grains was determined and the samples were then again annealed at 870 °C f...

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SOV/126-8-4-17/22

Some Peculiarities of Transformer Steel Recrystallization on Rapid Heating. III. Dependence of the Rate of Grain Growth and Activation Energy of this Growth on the Rate of Heating

15 minutes and the grain-size redetermined. The rate of growth at this temperature was determined from the difference. The experiment was repeated at 900, 942, and 975 °C. From a plot of the logarithm of the rate of growth against inverse of absolute temperature, an activation energy of 44000 cal/mol is obtained; allowing for an experimental error of ± 25% the minimum value is 33000 cal/mol, i.e. more than double the activation energy for rapid heating. The growth-rate values for the different temperatures for rapid and slow heating are tabulated, and their ratio is plotted against temperature in Fig 5.

There are 5 figures, 1 table and 7 references, of which 5 are Soviet, 1 is English and 1 is German.

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ASSOCIATION: Institut fiziki metallov AN SSSR (Institute of Physics of Metals, Ac.Sc. USSR); Sverdlovskiy gosudarstvennyy pedagogicheskiy institut (Sverdlovsk State Pedagogical Institute)

SUBMITTED: January 25, 1959

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PAVLOV, V.A.

PHASE I BOOK EXPLOITATION SOV/4502

Akademiya nauk SSSR. Nauchnyy sovet po probleme zharoprochnykh splavov

Issledovaniya po zharoprochnym splavam, tom 6 (Investigations of Heat-Resistant Alloys, Vol. 6) Moscow, 1960. 319 p. Errata slip inserted. 3,000 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Institut metallurgii imeni A. A. Baykova. Nauchnyy sovet po probleme zharoprochnykh splavov.

Editorial Board: I. P. Bardin (Deceased) Academician, G. V. Kurdyumov, N. V. Ageyev, Corresponding Member, Academy of Sciences USSR (Resp. Ed.), I. A. Oding, L. M. Pavlov, and I. F. Zudin, Candidate of Technical Sciences; Ed. of Publishing House: V. A. Klimov; Tech. Ed.: S. G. Tikhomirova.

PURPOSE: This book is intended for research workers in the field of physics of metals and for metallurgists, particularly those working on heat-resistant alloys.

COVERAGE: This collection of 45 articles deals with various problems in the production of heat-resistant alloys. Special attention is paid to the mechanisms of deformation of such metals as aluminum, copper, iron, and nickel. Various defects and failures of metals are analyzed, and means for increasing the heat-resistance and plasticity are described. Among the special problems discussed are: electrolytic conductivity of iron-aluminum alloys in the solid state; the mobility of atoms in nickel-iron alloys, depending upon defects of their crystalline structure; the kinetics of change in isolated pores; the irreversible thermal transformation of solid bodies, etc. No personalities are mentioned. References follow each article.

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PAVLOV, V. A.

PHASE I BOOK EXPLOITATION SOV/5305

Moscow. Institut stali

Relaksatsionnyye yavleniya v metallakh i splavakh; trudy Mezhvuzovskogo soveshchaniya (Relaxation Phenomena in Metals and Alloys; Transactions of the Inter-Institute Conference) Moscow, Metallurgizdat, 1960. 326 p.

Sponsoring Agency: Ministerstvo vysshego i srednego spetsial'nogo obrazovaniya RSFSR and Moskovskiy institut stali imeni I.V. Stalina.

Ed. (Title page): B.N. Finkel'shteyn; Ed. of Publishing House: Ye.I. Levit; Tech. Ed.: A.I. Karasev.

PURPOSE: This collection of articles is intended for personnel in scientific institutions and schools of higher education and for physical metallurgists and physicists specializing in metals. It may also be useful to students of these fields.

COVERAGE: The collection contains results of experimental and theoretical investigations carried out by schools of higher education and scientific research institutions in the field of the relaxation phenomena in metals and alloys. Several articles are devoted to the investigation—by the internal-friction method—of the decomposition of supersaturated solid solutions. Also analyzed are the defects of the crystalline lattice, plastic deformations, high-temperature behavior of alloys, and creep. Problems of the relation between internal friction and temper brittleness, the use of the method of internal friction in the investigation of powder-metallurgy products, and the mechanism of impact fatigue are discussed. The collection also contains articles on the damping characteristics of materials, elastic after-effect, and the new slow-detection method. No personalities are mentioned. References follow most articles. There are 366 references: 192 Soviet and 174 non-Soviet.

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18 8200

24588

S/137/61/000/005/042/060
A006/A106

AUTHORS: Datsko, O. I., and Pavlov, V. A.

TITLE: Temperature dependence of internal friction of pure nickel

PERIODICAL: Referativnyy zhurnal. Metallurgiya, no. 5, 1961, 32, abstract 5Zh244 (V sb. "Relaks. yavleniya v metallakh i splavakh", Moscow, Metallurgizdat, 1960, 234-240)

TEXT: The authors review studies on the effect of grain boundaries on internal friction in metal and present results of their investigations on the internal friction of Ni containing $\leqslant$ 0.013% impurities. The ingots were forged into rods from which 0.80 mm diam. wire was produced by rolling and drawing at room temperature with intermediate annealing. (Deformation after final annealing attained 80%). The temperature dependence of internal friction was studied with the aid of a twisting pendulum in a vacuum at about 0.5 cycles oscillation frequency. The deformed specimens were heated several times to different temperatures and internal friction was determined after each heating. A strong dependence of attenuation from the conditions of mechanical and thermal treatment was established which indicates that plastic deformation of a specimen causing the

X

Card 1/2

GAYDUKOV, M.G.; PAVLOV, V.A.

Dependence of creep in nickel-copper alloys on the concentration of solid solutions and deformation conditions. Issl. po zharopr. splav. 6:64-70 '60. (MIRA 13:9)
(Creep of metals) (Nickel-copper alloys--Metallography

S/126/60/009/02/015/0..
E111/E335

18.8200

AUTHORS: Pavlov, V.A. and Pereturina, I.A.

TITLE: The Influence of Alloying Additions on the Value and Temperature Dependence of the Yield Point

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol 9, Nr 2, pp 248 - 257 (USSR)

ABSTRACT: A discussion of results of previous investigations and of some new experimental data obtained on nickel and cobalt alloys is given. As in earlier work, the temperature dependence of the yield point of alloys is more complicated than that of pure metals. The position of the maximum on the temperature-yield point curves of alloys depends on the concentration of the alloying element and the rate of deformation. The change in character of the curve for alloys compared with pure metals cannot be explained by changes in interatomic bond strength. Experimental data and theoretical considerations indicate that the influence of alloying additions on the mechanical properties is due to interaction between dislocations and atoms or groups of atoms of the alloying element, which reduces the mobility of

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S/126/60/009/02/015/033
E111/E335

The Influence of Alloying Additions on the Value and Temperature Dependence of the Yield Point

the dislocations and sometimes increases the volume of metal taking part in deformation. This increases the efficiency of use of the interatomic bond strength. The influence of admixtures on the resistance to deformation can be explained qualitatively by assuming that there is (according to Cottrell and Suzuki) a relation between the dislocations and the atoms of the admixtures, that there are non-uniformities in the concentrations of the type K state and also a redistribution of the atoms in the stress field with mobile dislocations according to shock. The strongest influence is shown by additions which cause static distortions in the original crystal lattice. In nickel-cobalt alloys, where the static distortion caused by the cobalt is small, the strengthening is due to ordering. Acknowledgments are expressed to A.N. Orlov for his comments.
There are 5 figures and 35 references, 15 of which are English, 3 German and 17 Soviet.

Card 2/3

80222
S/126/60/009/04/029/033
E021/E435

18.7500

18

AUTHORS: Izbranov, P.D., Rodigin, N.M. and Pavlov, V.A.

TITLE: The Orientations of the Centres of Recrystallization at High Rates of Heating

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol 9, Nr 4, pp 630-633 (USSR)

ABSTRACT: To investigate the influence of high rates of heating on the distribution of the new grains, experiments on recrystallization of samples of a transformer steel were carried out. The rate of heating was 200000 °C/sec, which was made possible by using special equipment described in an earlier paper by one of the authors (Ref 3). Samples were prepared from cold rolled strip with 97% deformation. The recrystallized samples were investigated by metallographic and X-ray analysis. Fig 1 shows an X-ray photograph of the cold-worked sample, Fig 2 of the recrystallized sample, Fig 3 shows the equiaxed grains of the microstructure of the recrystallized sample. Comparison of Fig 1 and 2 shows that, in the main, the new orientations of the new crystals correspond to the orientations in the cold-worked

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KETOVA, V.P.; PAVLOV, V.A.

Effect of elastic waves on internal friction at low temperatures in aluminum alloys with 2 percent magnesium. Fiz. met. i metalloved. 10 no.3:445-452 S '60. (MIRA 13:10)

1. Institut fiziki metallov AN SSSR.
(Aluminum alloys—Testing) (Internal friction)

24.4200 3309 1327 1191 25920 S/126/61/012/001/012/020
18.8200 E193/E480

AUTHORS: Pavlov, V.A., Gaydukov, M.G., Noskova, N.I.
Mel'nikova, V.V.

TITLE: The role of slip and diffusion in plastic deformation during creep of nickel-copper alloys

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.12, No.1, pp.97-107

TEXT: This paper was presented at the session of the Nauchnyy sovet po probleme prochnosti i plastichnosti tverdykh tel AN SSSR (Scientific Council on the Problems of Strength and Plasticity of Solids AS USSR) in June 1960.
Slip or diffusion constitute the two possible mechanisms of plastic deformation. No agreement has been reached regarding the mechanism of plastic deformation in creep. According to one school of thought represented by S.N.Zhurkov, the diffusion processes play no significant part in plastic deformation in creep, an opposite view being held by the other school of thought represented by B.Ya.Pines. Since both these opinions are based on experimental data, the most likely explanation of this apparent contradiction is that either mechanism can operate depending on the
Card 1/8

25920 S/126/61/012/001/012/020
E193/E480

The role of slip and diffusion ...

conditions of stress and temperature, and the object of the present investigation was to study the effect of these two factors on the mechanism of plastic deformation in creep of Ni-Cu alloys. The Ni-Cu system was chosen for this purpose because (a) an increase in the Cu content in Cu-Ni alloys brings about a decrease in the elastic modulus and the characteristic temperature of these alloys and an increase in the magnitude of the static distortions of the crystal lattice and (b) the activation energy for diffusion of copper in nickel is almost 1.5 times higher than that for self-diffusion of pure nickel, the former amounting to 35000 to 40000 cal/mol. These data indicate that the addition of Cu to Ni decreases the interatomic bond forces and, consequently, increases the intensity of the diffusion processes, even at relatively low temperatures. The vacuum-melted experimental alloys, containing 10, 20, 40 and 60% Ni, were prepared from 99.99% Ni and electrolytic copper containing less than 0.05% impurities. The ingots were forged into 18 mm diameter rods from which the test pieces, 6 mm in diameter and 50 mm (for creep tests) or 100 mm (for stress relaxation tests) long, were prepared.

Card 2/8

25920 S/126/61/012/001/012/020
The role of slip and diffusion ... E193/E480

These were annealed at 800 to 900°C, the annealing temperature for each alloy having been selected so as to obtain the same grain-size (approx. 0.1 mm) in all test pieces. The rate of plastic deformation varied between 10^{-4} and 10^{-11} (sec^{-1}). In the first stage of the investigation, the effect of alloy composition and experimental conditions on the rate of deformation $\dot{\varepsilon}$ was studied. The results relating to steady creep are reproduced in Fig.1, where log $\dot{\varepsilon}$ (sec^{-1}) is plotted against the Cu content (%) in the alloys tested at 5 kg/mm^2. The test temperature is indicated by each curve. In Fig.2, log $\dot{\varepsilon}$ (sec^{-1}) is plotted against the Cu content (%) in alloys tested at 600°C, the magnitude of the applied stress (2 and 9 kg/mm^2) being indicated by each curve. In the next stage of the investigation the relationship between the applied stress σ and the activation energy Q of the deformation process was studied. The results are reproduced graphically. In Fig.5, Q (kcal/mol) is plotted against σ (kg/mm^2), the experimental points denoted by crosses, circles and dots relating, respectively, to pure nickel, 40% Cu-Ni alloy and 60% Cu-Ni alloy. In Fig.6, log $\dot{\varepsilon}$ (sec^{-1}) is plotted against $10^3/T$ (where T is the absolute temperature) for the 40% Cu-Ni
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$$\dot{\varepsilon} = \dot{\varepsilon}_0 e^{-\frac{Q - \gamma\sigma}{RT}}$$

High activation energy and the fact that the above relationship is valid for low temperature and high rates of deformation indicates that under these conditions plastic deformation in creep takes place predominantly by the mechanism of slip. (3) Under conditions of high temperature and low applied stresses, the activation energy for the deformation increases with decreasing stress and approaches the activation energy for the diffusion of the alloying element. In this case the process of deformation in creep can be described by the known equation for plastic deformation by diffusion:

$$\dot{\varepsilon} = \frac{D\sigma a^3}{l^2 kT}$$

Under these conditions of deformation the strength of alloys decreases and may be lower than that of unalloyed metal which indicates the predominance of the diffusion mechanism of deformation.

(4) In the intermediate region of temperature and stress, plastic deformation by slip takes place side by side with the diffusion relaxation process. The results of X-ray analysis indicate that under these conditions the plastic deformation brings about fragmentation of the crystals and formation of blocks. In this case the deformation in creep is approximately described by the formula due to J.J.Weertman (Ref.28: J.Appl.Phys., 1955, 26, 1213)

$$\dot{\varepsilon} = C\left[\sigma^{\alpha}/RT\right] \exp(-Q/RT)$$

There are 12 figures, 3 tables and 28 references: 18 Soviet and 7 non-Soviet. The four most recent references to English language publications read as follows: Ardley G.W. Acta met., 1955, 3, 525; Greenough A.P. Phil. Mag., 1958, 3, 1032; McLean D. Inst.Metals, 1952-53, 81, 287; Weertman J. J.Appl.Phys., 1955, 26, 1213.

ASSOCIATION: Institut fiziki metallov AN SSSR
(Institute of Physics of Metals AS USSR)

SUBMITTED: December 22, 1960

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012396

S/126/61/012/004/011/021
E111/E335

AUTHORS: Noskova, N.I. and Pavlov, V.A.

TITLE: X-ray-diffraction study of the fine structure of nickel iron after γ-α and γ-α-γ transformations

PERIODICAL: Fizika metallov i metallovedeniye, v. 12, no. 4, 1961, 580 - 582

TEXT: The authors point out that polymorphic changes contribute to the production of the strengthened state in metals. The reverse polymorphic transformation (alpha-to-gamma iron) has been insufficiently studied because of experimental difficulties and little information is available on the structural changes produced inside grains. Although block disorientation has been studied (Ref. 4 - Edmondson, Acta met., 1954, no. 2, 235), there is as yet no detailed picture on the fine structure after reverse transformation. The authors study block size and type II distortions in the present work, as a result of forward and reverse transformation of nickel iron (0.04% C, 0.38% Si, 0.33% Mn, 0.51% Cr, 28.23% Ni and remainder Fe). The temperatures of the martensite transformation and the
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APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012396

end of reverse transformation are -20 and 580 °C, respectively. Powder was used for the X-ray investigation, prepared by filing a rod, previously annealed at 1 100 °C, for 30 min. After sieving, the powder was vacuum-annealed (10^{-5} mm Hg) at 1 100 °C for 30 min and vacuum-cooled at 100 °C/min to room temperature and quenched in liquid nitrogen. The quenched powder was divided into two halves, each of which was vacuum-annealed for 1 hour at 100, 200, 300, 400, 500, 580, 600, 700, 900 or 1 100 °C and re-sieved. Cylindrical specimens, 0.7 mm diameter, were prepared from the powder and subjected to X-ray diffraction in a 150-mm diameter camera with Kα-iron radiation. The width of (111) and (222) diffraction lines of austenite and (110) and (220) of martensite were measured from photometry results, corrections being applied which were based on the method of Lysak (Ref. 7 - FMM, 1952, no. 3, p.28; 1955, no. 6, p. 40; 1954, no. 5, p. 45). The studied line width for alpha-iron was obtained from nickel-iron filing produced under nitrogen and then vacuum-annealed at 400 °C for 3 hours; for gamma iron - from filings vacuum-annealed at 1 100 °C for 30 min. The results

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10.7300 1413, 1327, 1454

S/126/61/012/005/017/028
E091/E335

AUTHORS: Pavlov, V.A., Gaydukov, M.G. and Mel'nikova, V.V.

TITLE: Mechanism of plastic deformation in the creep of aluminium-magnesium alloys

PERIODICAL: Fizika metallov i metallovedeniye, v. 12, no. 5, 1961, 748 - 755

TEXT: Pure aluminium and aluminium alloys containing 0.1, 1 and 2% Mg were investigated. The alloys were melted under flux in a high-frequency furnace. The ingots were forged into rods of 18 mm diameter, from which specimens 50 mm long and 8 mm in diameter were made for creep-testing and other 100 mm long and 8 mm in diameter for stress-relaxation testing. The specimens were annealed at 420 - 440 °C. Foreach alloy, the annealing temperature was selected so that a linear grain diameter of 0.1 mm should be obtained. The rate of plastic deformation was chosen within the limits $10^{-4}sec^{-1}$ to $10^{-10}sec^{-1}$. Rates below $10^{-8}sec^{-1}$ were obtained during stress-relaxation and the higher rates in creep. The mechanism of plastic deformation could be

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E091/E335

Mechanism of plastic ...

of activation with increase in stresses in the alloys as the diffusion mechanism of plastic deformation procees. S.N Zhurkov T.P Sanfirova, B.Ya. Pines and A.F. Sirenko are mentioned in the article in connection with their contributions in this field. There are 11 figures 1 table and 18 references: 14 Soviet-bloc and 4 non-Soviet-bloc The four English-language references mentioned are: Ref. 9: F.R. Nabarro - Rep. Conf. Strength of Solids, L 1948, 75, Ref. 10: C.J. Herring - J. Appl. Phys., 1950, 21, no. 5, 437, Ref. 11: J.J. Weertman - J. Appl. Phys., 1955, 26, 1213; Ref. 18: F.H Buttner, E.R. Funx, H. Udin - J Metals, 1952, 4, 401.

ASSOCIATION: Institut fiziki metallov AN SSSR (Institute of Physics of Metals of the AS USSR)

SUBMITTED March 27 1961

Card 3/3

S/126/61/012/006/021/023
E073/E535

AUTHORS: Kuznetsov, R.I. and Pavlov, V.A.

TITLE: Position of jumps on the extension diagram of polycrystalline tin

PERIODICAL: Fizika metallov i metallovedeniye, v.12, no.6, 1961, 919-921

TEXT: The authors investigated polycrystalline specimens of 99.999% purity tin of 2 mm diameter, 50 mm long with a grain size of 0.1 mm in the range from room temperature to -100°C and for deformation rates at $8 \cdot 10^{-2}$ to $2 \cdot 10^{-5}$ %/sec. A characteristic feature of the diagrams is the presence of jumps, the location of which depends on the speed and temperature during the tests. With a lowering of the temperature the region of the jumps shifts towards the initial point of the diagram if the deformation rate remains constant. At a constant temperature, the displacement is in the same direction as the increase in the speed of deformation. Thereby, the nature of the jumps does not change. It was found that the deformation ε, which corresponds to the first jump on the extension diagram, the deformation speed $\dot{\varepsilon}$ and the test

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temperature T are linked with the following relation:
$\dot{\varepsilon}\varepsilon = C \exp(-Q/kT)$, where C and Q are constants. Plotting this relation in the coordinates $\ln \varepsilon\dot{\varepsilon}$ - 1/T, a linear relation is obtained and from the inclination of the straight line expressing this relation the activation energy Q can be calculated which is approximately equal to 10 kcal/mol, which coincides with the activation energy of self-diffusion for tin. In view of the fact that the material was of very high purity, it is difficult to visualize that these jumps are associated with the presence of impurities in the metal. It can rather be assumed that their appearance is due either to twining during deformation or to polymorphous transformation of the tin from the β into α-modification during the process of deformation at a temperature which is below the transformation temperature, i.e. below 18°C. There are 2 figures and 12 references: 7 Soviet-bloc and 5 non-Soviet-bloc. The four latest English-language references read as follows: Ref.1: Ichii K. J.Phys.Soc., Japan, 1959, 14, 12, 1822. Ref.2: Basinski Z.S. Proc. Roy.Soc., 1957, A240, 1221, 229. Ref.9: Zener C., Hollmon S.H.

Position of jumps on the . S/126/61/012/006/021/023
E073/E535

J Appl.Phys., 1944, 15, 22; Ref.10 Thomson N. and Millard D.S.
Phil Mag., 1952, 7, 43, 422.

ASSOCIATION: Institut fiziki metallov AN SSSR
(Institute of Physics of Metals AS USSR)

SUBMITTED: July 28, 1961

Card 3/3

PHASE I BOOK EXPLOITATION SOV/6271

Pavlov, V. A.

Fizicheskiye osnovy plasticheskoy deformatsii metallov (Physical Principles of Plastic Deformation of Metals). Moskva, Izd-vo AN SSSR, 1962. 198 p. Errata slip inserted. 3000 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Institut fiziki metallov.

Resp. Ed.: M. V. Yakutovich; Ed. of Publishing House: V. I. Meder; Tech. Ed.: V. M. Fremd.

PURPOSE: This book is intended for scientific research workers and engineers concerned with problems of metal physics and metal science.

COVERAGE: The book reviews the principal physical laws governing plastic deformation under conditions of the conventional tensile test or creep. Data on the movement of dislocations in the re-

Card 1/7

gion of stresses are presented. Basic concepts of the mechanism of plastic deformation are explained from the standpoint of the theory of dislocations. The effect of alloying elements on plastic-deformation phenomena in single-phase solid solutions is discussed on the basis of investigations conducted by the author at the Institute of Physics of Metals, Academy of Sciences USSR. In addition, views are expressed on the mechanism of strengthening of single-phase solid solutions and on the mechanism of plastic deformation in creep. The author thanks Academician G. V. Kurdyumov, S. N. Zhurkov (Corresponding Member, Academy of Sciences USSR), E. S. Yakovleva, V. T. Shmatov, M. G. Gaydukov, N. I. Noskova, I. A. Pereturina, V. V. Mel'nikova, V. P. Ketova, and A. N. Orlov for their assistance. Each chapter is accompanied by Soviet and non-Soviet references.

JUN 25 1963

PHASE I BOOK EXPLOITATION SOV/6271

Pavlov, V. A.

Fizicheskiye osnovy plasticheskoy deformatsii metallov (Physical Principles of Plastic Deformation of Metals). Moskva, Izd-vo AN SSSR, 1962. 198 p. Errata slip inserted. 3000 copies printed.

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COVERAGE: The book reviews the principal physical laws governing plastic deformation under conditions of the conventional tensile test or creep. Data on the movement of dislocations in the re-

Card 1/3

gion of stresses are presented. Basic concepts of the mechanism of plastic deformation are explained from the standpoint of the theory of dislocations. The effect of alloying elements on plastic-deformation phenomena in single-phase solid solutions is discussed on the basis of investigations conducted by the author at the Institute of Physics of Metals, Academy of Sciences USSR. In addition, views are expressed on the mechanism of strengthening of single-phase solid solutions and on the mechanism of plastic deformation in creep. The author thanks Academician G. V. Kurdyumov, S. N. Zhurkov (Corresponding Member, Academy of Sciences USSR), E. S. Yakovleva, V. T. Shmatov, M. G. Gaydukov, N. I. Noskova, I. A. Pereturina, V. V. Mel'nikova, V. P. Ketova, and A. N. Orlov for their assistance. Each chapter is accompanied by Soviet and non-Soviet references.

39752
S/126/62/014/001/008/018
E193/E383

18.8200

AUTHOR: Pavlov, V.A. and Pereturina, I.A.

TITLE: The effect of alloying additions on the mechanics of plastic deformation of alloys and on the shape of the stress/strain diagram

PERIODICAL: Fizika metallov i metallovedeniye, v. 14, no. 1, 1962, 92 - 98

TEXT: The object of the work described in the present paper was to analyze a large body of experimental data obtained by the present authors and by other, both Soviet and foreign, workers and to correlate data relating to pure metals (Al, Ni) and alloys (Al-Mg, Ni-Cu, Ni-Al, Ni-Co) in order to evaluate the effect of alloying on some aspects of plastic deformation of metals. The first chapter is devoted to the temperature-dependence of the yield point. The effect of alloying on this relationship is demonstrated schematically in Fig. 1, where the yield point (σ) is plotted against temperature (T), curves 1 and 2 relating, respectively, to pure metals and alloys. The

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...ver, ... point of metals. ...e yield point (σ, kg/mm²) ... indicated by each curve is plotted against the Cu content (%). The presence of a maximum on curves of this type has been attributed to the refining (purifying) effect of small alloying additions. Since, however, the magnitude of this effect in Ni-Al alloys decreases with increasing rate of strain (or with decreasing temperature in the case of Ni-Cu alloys) it is obvious that it must be caused by some other factors. Passing-on to the effect of alloying additions on the shape of the true-stress/strain diagram, the authors distinguish between two types of this diagram. In the low-temperature type, the stress reaches its maximum near the end of the diagram (i.e. at high strain values) after which it decreases rapidly due to the onset of localized deformation (necking); in the high-temperature type the maximum of the true stress is reached near the beginning of the diagram (i.e. at low strain values); after that the stress remains constant or slowly decreases and finally falls down rapidly when the neck begins to form. In all the systems studied the introduction of alloying elements raises the temperature at which the stress/strain diagram changes from the low-temperature to the high-temperature type. The addition of alloying elements increases also the value

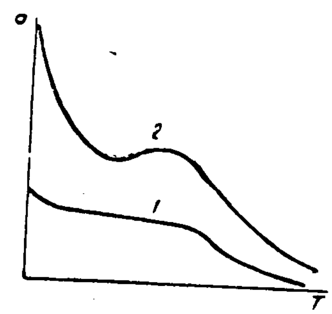
The effect of alloying S/126/62/014/001/008/018
E193/E383

of stress σ_{III} at which the parabolic increase in the resistance-to-deformation of strained metal begins. This indicates a decrease in the energy of the stacking faults. There are 9 figures.

ASSOCIATION: Institut fiziki metallov AN SSSR (Institute of Physics of Metals of the AS USSR)

SUBMITTED: July 29, 1961 (initially)
December 27, 1961 (after revision)

Fig. 1:



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40678
S/126/62/014/002/012/018
E193/E383

AUTHORS: Pavlov, V.A., Gaydukov, M.G. and Mel'nikova, V.V.

TITLE: Dependence of the mechanism of plastic deformation in creep of Ni-Al and Ni-Co alloys on the conditions of deformation

PERIODICAL: Fizika metallov i metallovedeniye, v. 14, no. 2, 1962, 275 - 282

TEXT: In continuation of their earlier work on the mechanism of creep of Ni-Cu and Al-Mg alloys, the present authors investigated the effect of various factors on the mechanism of creep of Ni-Al and Ni-Co alloys. The Ni-Al alloys, containing up to 5% Al were chosen as one of the experimental materials because they represented alloys characterized by relatively large static lattice distortions and non-monotonic concentration-dependence of the elastic modulus. In contrast, the lattice distortions in Ni-Co alloys (with up to 60% Co) were relatively small and their elastic modulus was practically independent of the composition. The creep tests were carried out at 500 and 800 °C, the rate of

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S/126/62/014/002/012/013
E193/E383

Dependence of ....

creep varying between 10^{-4} and 10^{-2} sec^{-1}. The results are reproduced in the form of graphs, showing: concentration-dependence of the rate of creep under various applied stresses; relationship between the rate of creep and the yield point; stress-dependence of the activation energy for creep of the alloys studied; stress- and temperature-dependence of the rate of creep. The conclusions reached can be summarized as follows. 1) Slip is the predominant mechanism of plastic deformation ... creep at relatively low temperatures and high stresses. The relationship between the rate of creep under these conditions, on the one hand, and temperature and stress, on the other, can be described by an expression due to Zhurkov and Sanfirova (DAN SSSR, 1955, 101, no. 2, 257):

$$\dot{\varepsilon} = \dot{\varepsilon}_o e^{-\frac{Q-\gamma\sigma}{RT}} \qquad (1)$$

where Q is the activation energy for creep at $\sigma = 0$ and $\dot{\varepsilon}_o$ and γ are constants. Under these conditions, the rate of

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E193/E383

Dependence of ....

creep can be correlated with the yield point of the alloy.
2) In creep at high temperatures and under low stresses the diffusion mechanism of plastic deformation predominates and there is a definite temperature and stress range within which the rate of creep increases linearly with increasing stress.
3) In the intermediate range of stress and temperature deformation by slip takes place side-by-side with the relaxation processes. The approximate rate of creep can be obtained, under these conditions, from an equation due to J.J. Weertman (J. Appl. Phys., 1955, 26, 1213):

$$\dot{\varepsilon} = c(\sigma^{\alpha}/RT)\exp()Q/RT) \qquad (2)$$

where Q is the activation energy for diffusion,
σ is the stress and
α a coefficient equalling 3-4.
4) The range of temperature and stress in which the diffusion mechanism of deformation predominates is wider in alloys than in pure metals. The same applies to the range in which plastic

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Dependence of S/126/62/014/002/012/018
E193/E383

deformation in creep is described by Weertman's equation. Thus, the stress dependence of the activation energy for creep ceases to be linear at 6 - 7 kg/mm^2 for pure nickel and at 10-12 kg/mm^2 for the 60% Co-Ni alloy.
5) The onset of the diffusion mechanism of plastic deformation in the alloys studied is facilitated by polygonization.
There are 12 figures.

ASSOCIATION: Institut fiziki metallov AN SSSR
(Institute of Physics of Metals, AS USSR)

SUBMITTED: July 28, 1961 (initially)
March 2, 1962 (after revision)

Card 4/4

NOSKOVA, N.I.; PAVLOV, V.A.

Defects of packing in solid solutions of nickel. Fiz.met.i metalloved. 14 no.6:899-803 D '62. (MIRA 16:2)

1. Institut fiziki metallov AN SSSR.
(Nickel alloys—Metallography)
(Crystal lattices)

L 18076-63 EWP(q)/EWT(m)/BDS AFFTC/ASD Pad JD/HW/JG

ACCESSION NR: AP3004608 S/0126/63/016/001/0155/0158

AUTHOR: Pavlov, V. A.

TITLE: Hardening of alloys by plastic deformation at temperatures producing anomalous relationship between mechanical properties

SOURCE: Fizika metallov i metallovedeniye, v. 16, no. 1, 1963, 155-158

TOPIC TAGS: alloy, hardening, plastic deformation, temperature, anomalous property, beryllium bronze, Fe-Ni-Cr-Ti, duralumin

ABSTRACT: Detailed experimental data obtained in the study of the deformation temperature effect on the strength and plasticity of alloys are presented in this article. Three types of high-strength alloys were investigated: beryllium bronze BrB2, Fe-Ni-Cr-Ti alloy, and duralumin. It was determined that hardness of BrB2 increases with the deformation temperature and reaches a maximum at 350C, after which it begins to decline. The deformation at optimum temperature produced a 30% increase in the elastic limit and a 25% increase in ultimate strength of the metal. The hardening coefficient of the Fe-Ni-Cr-Ti alloy reaches its maximum at 600C, producing a 40% increase in strength as compared to a sample in its initial condition and one deformed at room temperature. In the case of duralumin, the maximum

Card 1/2

L 18076-63

ACCESSION NR: AP3004608

strength and plasticity were obtained with the preliminary deformation at 100C; the increase in strength reached 70%. The plastic properties of the sample so deformed were much higher than those after the deformation at room temperature. Orig. art. has: 1 table and 3 figures.

ASSOCIATION: Institut fiziki metallov AN SSSR (Institute of Physical Metallurgy, Academy of Sciences, SSSR)

SUBMITTED: 11Feb63 DATE ACQ: 27Aug63 ENCL: 00

SUB CODE: ML NO REF SOV: 003 OTHER: 000

Card 2/2

L 17699-65 EWT(m)/EWP(w)/EWA(d)/EWP(k)/EWP(t)/EWP(b) Pf-4/Pad MJW/JD/HW

ACCESSION NR: AP4042041 S/0126/64/017/006/0845/0852

AUTHOR: Sadovskiy, V. D.; Sokolkov, Ye. N.; Petrova, S. N.; Pavlov, V. A.; Gaydukov, M. G.; Noskova, N. I.; Kagan, D. Ya.

TITLE: The effects of high-temperature thermo-mechanical treatment on the heat resistance of KhN77TYuR alloy

SOURCE: Fizika metallov i metallovedeniye, v. 17, no. 6, 1964, 845-852

TOPIC TAGS: nickel alloy, chromium containing alloy, aluminum containing alloy, creep rate, recrystallization, boron containing alloy, KhN77TYuR alloy, thermo mechanical treatment, heat resistance

ABSTRACT: The method of hot plastic deformation combined with quenching was used to enhance the stress-rupture strength of austenitic steels. The authors investigate the possibility of applying this combined method to KhN77TYuR, a nimonic-type alloy. Specimens 11.5 x 11.5 x 70 mm were annealed at 1080C for 8 hr. and rolled with a reduction of 25% at a rolling speed of 1.5 m/min. The process

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ACCESSION NR: AP4042041

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of recrystallization was suppressed by water cooling the specimens immediately after plastic deformation. All specimens were aged at 750C for 16 hr. Hardness was 285 HB. At 550C and under a stress of 90 kg/mm^2, the rupture life was extended from 4 to 100 hr while the creep rate decreased from 4-8 x 10^{-2}% to 8 x 10^{-1}% per hr. Above the 500—600C range a deterioration of strength characteristics was observed. The authors attribute the adverse effect of the combined method at 750C to the recrystallization during testing and to a possible higher rate of coagulation of the strengthening phase. The decrease in the creep rate and the increase of the rupture life were verified by x-ray method. The authors point out the formation of a polygonized substructure and to a boundary distortion in the form of characteristic serration during high-temperature deformation. They contend that the substructural boundaries impeded the travel of dislocations during creep, while the distortion of the grain boundaries lowered the susceptibility to intercrystalline failure. The authors suggest that the method of investigation may be insufficiently developed for an exhaustive interpretation of the results obtained and of the peculiarities of the structural state of the material. Orig. art. has: 5 figures.

Card 2/3

L 17699-65

ACCESSION NR: AP4042041

ASSOCIATION: Institut fiziki metallov AN SSSR (Institute of the Physics of Metals AN SSSR)

SUBMITTED: 12Jul63 ENCL: 00 SUB CODE: MM

NO REF SOV: 012 OTHER: 008

Card 3/3

GAYDUKOV, M.G. (Sverdlovsk); MALYSHEV, K.A. (Sverdlovsk); PAVLOV, V.A. (Sverdlovsk)

Increasing the heat resistance of an iron-nickel alloy by precipitation hardening. Izv. AN SSSR. Met. no.5:187-19[illegible] S-[illegible] '65. MIRA 1[illegible]

L 10260-66 EWT(m)/EWP(w)/T/EWP(t)/EWP(z)/EWP(b)/EWA(c) IJP(c) JD/HW

ACC NR: AP5026369 SOURCE CODE: UR/0370/65/000/005/0187/0192

AUTHOR: Gaydukov, M. G. (Sverdlovsk); Malyshev, K. A. (Sverdlovsk); Pavlov, V. A. (Sverdlovsk)

ORG: none

TITLE: Effect of phase transformation-induced strain hardening on the heat resistance of iron-nickel alloy

SOURCE: AN SSSR. Izvestiya. Metally, no. 5, 1965, 187-192

TOPIC TAGS: iron alloy, heat resistant alloy, nickel containing alloy, titanium containing alloy, strain hardening, iron base alloy, rupture strength, heat resistance, solid mechanical property

ABSTRACT: Two iron-base alloys containing 1) 0.06% C and 28.9% Ni, and 2) 0.04% C, 1.73% Cr, 24.5% Ni, and 2.32% Ti were tested for the effect of transformation-induced strain hardening on mechanical properties at room and elevated temperatures. Alloy specimens were austenitized at 1200C and quenched in liquid nitrogen and then annealed at 600, 700, and 800C (alloy 1) are at 900 and 1100C (alloy 2). In alloy 1 the maximum effect was produced by annealing at 600 or

UDC: 669.15'24-177

Cord 1/2

L 10260-66
ACC NR: AP5026369

700C, which increased the yield strength to 41 and 37 kg/mm^2, respectively. Annealing at 800C lowered the yield strength to 13 kg/mm^2 and increased the elongation to 40--46%. In stress-repture tests at 400C, alloy 1 annealed at 700C had a rupture life of 837 or 55 hr under a stress of 36 or 38 kg/mm^2, respectively, while conventionally treated (annealed at 1200C) alloy under a stress of 30 or 32 kg/mm^2 had a rupture life of 68.5 or 1.2 hr, respectively. At 600C the positive effect of strain hardening is maintained for a relatively short period of time, not exceeding 100 hr. The effect of transformation-induced strain hardening on alloy 2 was considerably greater. Alloy 2 annealed (after quenching) at 900C had a 100-hr rupture strength at 700C of 17.5 kg/mm^2, compared to 3.5 kg/mm^2 for alloy 1. Orig. art. has: 4 figures and 2 tables.

SUB CODE: 11/ SUBM DATE: 06May65/ ORIG REF: 016/ OTH REF: 002/ ATD PRESS: 4160

Card 2/2 hw

NOSKOVA, N.I.; PAVLOV, V.A.

Defects of packing in face-centered cubic metals and alloys. Fiz. met. i metalloved. 20 no.3:428-432 S '65. (MIRA 18:11)

1. Institut fiziki metallov AN SSSR.

VSHIVKOVA, N.F.; NOSKOVA, N.I.; PAVLOV, V.A.

Deformation defects of packing in rhodium and irridium.
Fiz. met. i metalloved. 20 no.3:480 S '65.

(MIRA 18:11)

1. Institut fiziki metallov AN SSSR.

L 10890-66 EWT(m)/EWA(d)/T/EWP(t)/EWP(z)/EWP(b) IJP(c) MJW/JD

ACC NR: AP5028566 SOURCE CODE: UR/0126/65/020/005/0770/0774

AUTHOR: Pavlov, V. A.; Filippov, Yu. I.; Frizen, S. A.

ORG: Institute of Metal Physics, AN SSSR (Institut fiziki metallov AN SSSR)

58
B

TITLE: Strengthening AV and V95 aluminum alloys by thermomechanical treatment

SOURCE: Fizika metallov i metallovedeniye, v. 20, no. 5, 1965, 770-774

TOPIC TAGS: aluminum, aluminum alloy, annealing, solid mechanical property, mechanical heat treatment, metal aging/AV aluminum alloy, V95 aluminum alloy

ABSTRACT: AV and V95 aluminum-alloy bars 12 mm in diameter were solution annealed, water quenched, and then subjected to low temperature thermomechanical treatment (LTTMT): preheated to 100—300C, rolled in one pass with a reduction of 20%, and water quenched. LTTMT was followed by aging at 150C (AV alloy) or 120C (V95 alloy). LTTMT with rolling at 150C significantly improved the strength characteristics of AV alloy (see Fig. 1). After LTTMT and aging for 6 hr at 150C the alloy had a tensile strength of 41.3 kg/mm^2, a yield strength of 34 kg/mm^2, an R_B hardness of 70, a work-hardening factor of 0.7, and an elongation of 15%, compared to 32.5 kg/mm^2, 26.0 kg/mm^2, 70, 0.4, and 22% for conventionally treated alloy. LTTMT also accelerated the decomposition of

Card 1/2

UDC: 669.715:539.43

L 10890-66

ACC NR: AP5028566

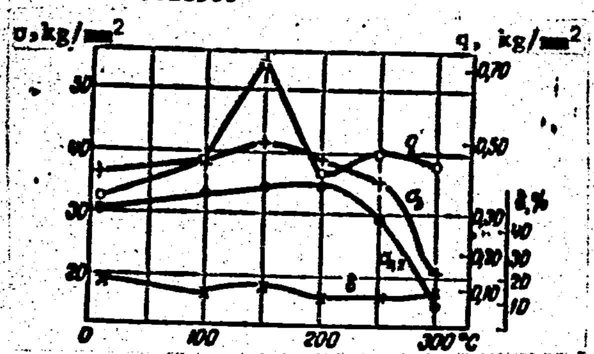


Fig. 1. Deformation temperature dependence of tensile strength (σ_B), yield strength ($\sigma_{0.2}$), elongation (δ), and work-hardening factor (q) of AV alloy aged at 150C for 6 hr

the solid solution. Conventionally treated alloy required 12 hr aging at 150C while thermomechanically treated alloy required only 6 hr. Alloy V95 exhibited similar behavior but was much less responsive to LTTMT. After LTTMT and aging at 120C for 6 hr, V95 had a tensile strength of 60.3 kg/mm^2, a yield strength of 47.5 kg/mm^2, an R_B hardness of 83, a work-hardening factor of 1.0, and an elongation of 7.8% compared to 57.6 kg/mm^2, 42.2 kg/mm^2, 82, 0.92, and 9% for conventionally treated alloy. Orig. art. has: 7 figures and 2 tables.

[DV]

SUB CODE: 11, 13/ SUBM DATE: 29Jan65/ ORIG REF: 003/ ATD PRESS: 4170

HW

Card 2/2

ACC NR: AP6021816 (A) SOURCE CODE: UR/0413/66/000/012/0109/0109

INVENTOR: Sinenko, N. P.; Mats, Z. Z.; Fayn, M. A.; Skazhennik, A. M.; Pavlov, V. A.; Rubinfayn, L. Ye.

ORG: None

TITLE: A unit for sealing turbine compressor bearings. Class 46, No. 182957 [announced by the Kharkov Transport Machine Building Plant im. V. A. Malyshev (Khar'kovskiy zavod transportnogo mashinostroyeniya)]

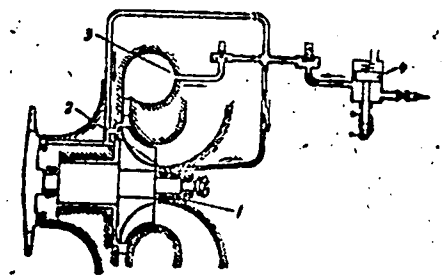
SOURCE: Izobreteniya, promyshlennyye obraztsy, tovarnyye znaki, no. 12, 1966, 109

TOPIC TAGS: sealing device, turbine compressor, journal bearing

ABSTRACT: This Author's Certificate introduces a unit for sealing turbine compressor bearings used in diesel engine blower systems. This unit contains labyrinth packings with air seals fed by compressed air from the turbine compressor shell. Oil is kept out of the turbine compressor during idling and low-load operation by connecting the air seals to the locomotive braking system which is coupled by an electromagnetic valve interlocked with the locomotive control system.

Card 1/2 UDC: 621.515.5-762:62;621.436.052

ACC NR: AP6021816



1--labyrinth packings; 2--air seals; 3--compressor shell; 4--electromagnetic valve

SUB CODE: 13/ SUBM DATE: 12Jun65

Card 2/2